September 1994 Issue

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Radio Fun

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"The beginner's guide to the exciting world of amateur radio."

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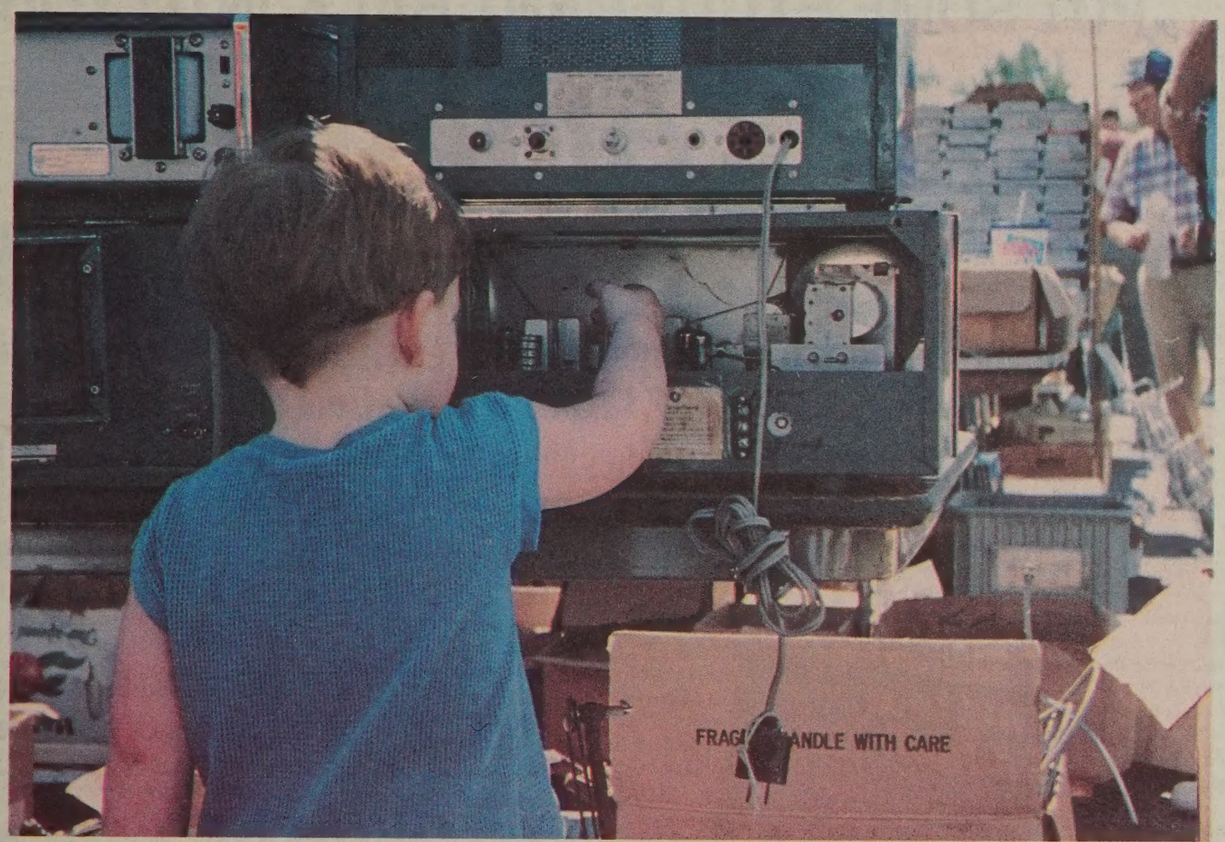
Finding the Best Deal on Used Ham Gear



You can't start too early—learning the ABCs of ham radio bargain hunting! Will you pay too much for your radio equipment? Will you buy the right rig?Turn to "Buying Used HF Gear" on page 4. (Photo by Charles Warrington WA1RZW.)

Three National Capitol DX Assn. members collectively worked 665 countries in the NCDXA 12-month DX hunt. Pictured (L to R) are: Dave Hammond WC4B (201), Ken Miller K6IR (227), and ARRL Director John Kanode N4MM (237).

Entire ARRL Bio-Effects Committee Quits

The American Radio Relay League's Bio-Effects Committee has disbanded en masse. The handpicked group of internationally acknowledged experts in the field of potential health risks from exposure to RF radiation formally resigned in writing on June 1st. In the letter of resignation, signed by all five members, Chairman Ivan Shulman, M.D., WC2S wrote: "We will, however, not allow our names to be subject to the political machinations and narrow views of individuals who seek to use us for their own aims as 'window dressing' . . ."

The ARRL published an article in the April 1994 issue of *QST* by Wayne Overbeck N6NB which stated, "Fortunately, enough research has now been done that we know most amateur radio activities are quite safe." Meanwhile, the May issue of *73* carried actual Congressional testimony by former ARRL committee member Ross Adey, M.D., K6UI in an article called "The Radar Gun Reality." Dr. Adey stated that federal agencies " . . . should assume direct responsibility for developing and implementing urgently needed safety guidelines for RF/microwave exposures." He added that more research was desperately needed, especially in the athermal effects of radiation.

The ARRL Bio-Effects Committee was appointed in January 1990 by then ARRL President Larry Price W4RA " . . . with the distinctive charge of revitalizing organized amateur radio's concern for the limitation of bio-effects hazards that might arise from the participation of individuals in the hobby of amateur radio." *TNX W5YI Report, Issue #12, June 15, 1994; QST, April, 1994.*

This Month in 73 Amateur Radio Today

If you don't read the September issue of *73 Amateur Radio Today*, here's what you'll be missing:

• The latest antenna projects are all here in this Special Antenna Issue!

• Do you still think operating 160 meters requires moving to wide-open spaces? How about building a "Compact 160 Meter Transmitting Loop Antenna" instead? Richard Marris G2BZQ will show you how.

• Tune out a lot of QRM and QRN with "The Discriminator," a directional receiving antenna covering 1600 to 4000 kHz. Build this low-cost ferrite loop for high-performance reception of amateur, marine, aircraft, and shortwave broadcast bands!

• Did you know that you can match your rig to a feedline made of cheap lamp cord and still transmit an efficient signal? Don't try it until you read "Low-Cost Transmission Lines," by Frank Kamp K5DKZ, in the September issue.

• *73* always brings you great reviews, and September is no exception:

• Read all about the German-built "HOFI Antenna Switch." Bill Clarke WA4BLC reviews the ins and outs.

• Then, you'll read about the new Yaesu FT-11R Miniature HT, reviewed by Michael Geier KB1UM.

• *73* readers have come to expect the best columns, and they won't be disappointed this month. For starters, Joe Carr K4IPV brings you "Out of This World DX" in this month's "Carr's Corner."

• How about Kanga Kit's new LCK-80 superhet receiver? Michael Bryce has the story in this month's "QRP."

• What do you think about an eight-year-old with an Extra Class ticket? Maybe you'll upgrade after reading about him in Carole Perry WB2MGP's "Hams With Class."

You should read the September issue, and *every* issue, of ***73 Amateur Radio Today!*** Order now and save $15 off the cover price. You'll receive a one-year subscription (12 issues in all) to the best ham radio magazine money can buy, for just $19.97. For instant service call toll-free (800) 289-0388. Do it today!

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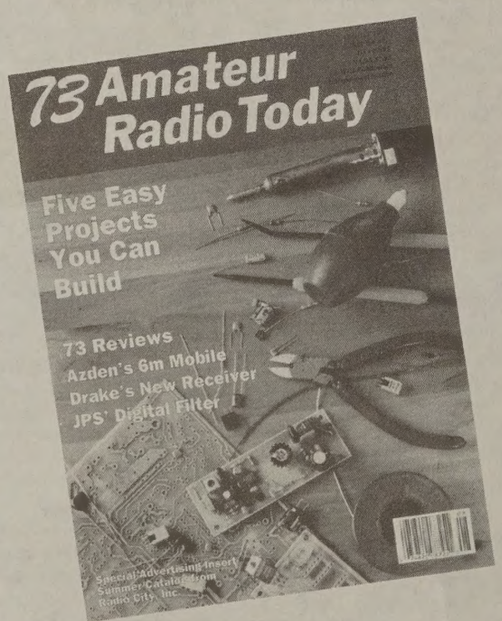

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QLF

by Wayne Green W2NSD/1

OSCAR

It was a while ago, back in OSCAR-7 days, that I got the bug. The satellite input was on 450 MHz and the output on 145.95 MHz. So I took a 2m rig and added a tripler to get my 450 MHz sideband signal. I knew I'd need a pair of shoes, so I borrowed a 450 MHz amplifier from my buddy Chuck WA1KPS. The 2m downlink was easy, with a 2m converter into my station receiver. Another friend, Sandy KS1C, helped Chuck and me get the antenna set up.

Then I set up a world globe with a circle on it showing the area within which I should be able to access the satellite. I had fairly good coverage of Europe on the best swings. It took a little practice to listen to the downlink and find my signal, but there it was, complete with a little echo delay due to the distance.

Europe was easy when OSCAR was out over the Atlantic Ocean. I was limited in that direction by a nearby mountain, just a few miles to the east of my shack, so the very furthest I could hope to reach was Moscow, and that would only be possible when OSCAR was just barely within the edge of the circle on my globe. It calculated out to my having about a 20-second window if I could catch the satellite on the right orbit at exactly the right time—and if there was someone on the other end on the right frequency at the right time. It all came together one day and suddenly I had my Moscow contact, and without any schedule or planning. We were both very lucky.

That's one of those exciting moments in amateur radio that I'll never forget.

When I moved to New Hampshire a little over 30 years ago, just a couple years after I'd started *73*, I had a bunch of college drop-out hams working for me for room, board, and $20 a week in spending money. We all lived in the 40-room old New England house and had a ball putting out the magazine.

When a summer cottage came available about 2,500 feet up on the side of Mount Monadnock, only about 10 miles away, I bought it and the bunch of us started putting up towers and antennas. We had a great time. The biggest monster was for 2m, where we had a 336-element beam. There were three 96-element beams fixed toward the southeast, shooting down the East Coast, and a 48-element rotatable on top of the tower.

The receiver started with a low-noise converter into a NC-300 receiver, and the transmitter ended up with a pair of 4-125As running a kilowatt. It was a war surplus amplifier I'd converted to 2m. The power supply and AM modulator were from an old pre-war National-600 transmitter I'd bought soon after the war and put a modest 2 kW of audio on the kilowatt carrier. Talk about punch!

I was able to sit up there on my mountain at night, call CQ once and then, starting at the low end, work stations every few kHz up the band, often working a hundred or so in an evening. Heck, I could hear a Benton Harbor Lunch Box three hundred miles away. Anyone remember the Twoer? I remember one chap using a coat hanger hanging out of his car window and a Twoer, working me as he drove down the New Jersey Garden State Parkway. And a chap on a mountain in West Virginia with a Gonset.

There was one chap in Hampton, Virginia, about 600 miles down the coast, who was smart enough to transmit where I said I was listening, so I often talked with him. He said my signal was never less than S7, even under the worst of band conditions. It was fun being king of the hill like that.

I also had a whopping signal on 6m, with a 16-element collinear antenna and a kilowatt. I was active on 220 with a couple hundred elements, but there weren't many people to talk with there. Ditto 450 MHz. I'm talking about 1964, before FM and most repeaters. Oh, there were a few AM repeaters—mostly in Los Angeles. And I'd helped W2BFD set up a 2m repeater for RTTY in 1950 in downtown Manhattan. But at this time repeaters were just getting started. I might have helped make repeaters more popular five years earlier than they did, but the ARRL did a job on me.

The repeater idea seemed great to me, so I made a deal with a surplus sales company in Massachusetts to let me buy a rig and get it set up. I sent one of my drop-out hams down there to convert a 440 MHz rig to be used as a control link between our offices (my house) and the shack on the mountain. We were going to run a couple hundred watts with the receiving antenna separated by about a half mile.

Before the work on the control link was finished I found myself confronted by the government. The Employment people said that the ARRL had complained that since the station was connected to *73* magazine that any operator would have to be paid at least the minimum wage. When I pointed out that the FCC regulations made it illegal to pay operators, they said that the ARRL was paying theirs. So I appealed to the FCC, asking how my operators could also be allowed to be paid to operate. The FCC refused to answer repeated requests. Eventually, after I was a real itch about it, the FCC formally asked for comments by amateurs on how the rules could be changed to allow the ARRL to continue to pay their operators. As far as I know, the FCC solved the problem by forgetting about it and ignoring the ARRL's breaking the law.

I finally gave up, took down my antennas and towers, gave them to some Boston hams for their VHF contest club use, and sold the house. Well, we sure had fun while it lasted.

In 1969 I set up a repeater on Pack Monadnock, which was much closer to my house. I put the receiver on top of the ranger's house on top of the mountain and ran a wire a half mile down through the woods to the tower and transmitter shack for the local FM broadcast station. With that separation I was able to run a fair amount of output power without overloading the receiver. The repeater made it so mobile ops way up in Maine could talk with others down on Cape Cod. It covered most of New England with a walloping signal.

Since they only cost $6 a month each, I used a couple of telephone lines coming down to my house as a control link.

This repeater was great—until the disaster. One weekend, when the Boston club was up on the Pack for the VHF contest, using my old antennas and towers, they put out a humongous signal on 6m which wiped out every TV set in town. I called 'em when I heard it, but they were working out so well on 6m that they refused to stop. They said the town would just have to live with the TVI.

The woman who owned the top of the mountain lived across the street from me and she was not about to put up with TVI. She was furious. So she got even by telling the FM station that if they continued to permit my repeater to use their tower, they'd lose their transmitting site. I had to move my transmitter to the top of the mountain, near the receiver. I tried several duplexers, but none came even close to allowing the receiver sensitivity I had with the half-mile separation. Oh, the repeater was OK, but it would never cover New England again.

"Once we're no longer needed for emergency communications, and we've been left hopelessly behind by technology, what role will there be which warrants our use of tens to hundreds of billions of dollars worth of frequencies?"

I set it up with crossband operation to 6m and 10m, making it so anyone using it could make contacts all around the world on 10m via the repeater. When the repeater licenses were permitted I got WR1AAB for it. I would have gotten WR1AAA, but the FCC was afraid that they'd be accused of favoritism, so they gave the AAA call to a chap in Skunk Hollow, Massachusetts.

For a while the FCC outlawed crossbanding repeaters, so I had to disconnect my 6 and 10m link systems. Eventually they backed off. I'd like to see more 2m repeaters able to repeat on 6, 10, and the lower bands.

I set up a small repeater at my house just for remote-controlling my 20m station. With that I was able to take my daily walks, HT in hand, and make 20m contacts as I walked. I'd love to see some articles submitted on remote control systems which will rotate the antenna and tune the station transceiver via a 2m link. With today's digitally controlled rigs it should be a snap.

Other Matters

Remind me to tell you about the scams some famous DXers have pulled. One chap claimed he was making over $50,000 a year going on DXpeditions, and I believe him.

I see that ARRL's Bio-Effects committee has quit en mass in protest over League policy. I suspect they were infuriated when *QST* published an article suggesting that amateurs have little to fear from magnetic fields. This sounds like it was dictated by advertisers worried about the harmful effects of radiation from their equipment, not from any scientist knowledgeable in the field.

And the FCC is getting ready to start auctioning off some ham frequencies, just as I've predicted. I hope the hams who wrote me saying I was a doom and gloomer and it would never happen will be less taken in next time.

As my new *"Cold Fusion"* magazine is into its fourth issue, that field is developing rapidly. There are a growing number of theories as to why cold fusion works, and less controversy over whether it does or not. So many labs are producing power now that the skeptics are seeking cover.

It started out with palladium and heavy water, which are fairly expensive. Now they're routinely getting results with nickel and plain water. The phenomenon is still in the laboratory being researched, but I expect we'll see some commercial units appearing within a year. Remember, it was two years after I started publishing *Byte* before the first practical personal computer reached the market. That was the Radio Shack TRS-80.

For the adventurous that means that the field is still wide open for pioneers and entrepreneurs. And this is a technology that can be researched in your garage, as a young chap in Vernon, Texas, has proven. With less than $5,000 invested in his lab he's been having remarkable success.

Of course, I realize that our school system has been working with amazing success to eliminate initiative in youngsters, with the result that we're having trouble recruiting new hams, much less encouraging garage or cellar laboratory experimentation.

Some recent reader letters commented on how impressed many kids were with the D-Day TV programs. When the Revolution came Americans volunteered to fight. They did it again when the Civil War came. The people who founded our country were willing to fight for it. The same was true in WWI and WWII. We had about 50,000 licensed hams when WWII started and 40,000 of them volunteered for military duty. I could make a very good case for those hams being critically important to that war. We won the war mainly due to our technology and hams were key in the development, building, and operating of the technology.

Now we have a draft-dodging President as our role model.

When I went to the Navy radar school virtually every teacher was a ham. Our classes were packed with hams. The research labs were packed with hams. Well, almost every ham in those days got started in the hobby at around 13-14 years of age, so a high percentage of them went on to high-tech careers. An ARRL study in the late 1950s showed that 80% of all new hams were teenagers, and that 80% of them went on to high-tech careers. Thus, a high percentage of our research scientists started out as hams.

The League put a stop to all that nonsense in 1963, as I've written a few times. Today youngsters represent around 15% of our new hams, and are no longer a significant source of scientists.

I was pleased to meet a nine-year-old Extra Class ham at the Dallas Hamfest. Alas, he stood out among the overwhelming crowd of old-timers coming by the *73* booth in their wheelchairs or with their walkers. The sprier had canes. I was pleased to meet so many hams who've been reading my rambling editorials for over 30 years, and a few for over 40 years!

As I see the shadow of the coming information superhighway looming closer, I wonder how much longer amateur radio will be around. Once we're no longer needed for emergency communications, and we've been left hopelessly behind by technology, what role will there be which warrants our use of tens to hundreds of billions of dollars worth of frequencies?

Using modern communications technology we can send all of the words ever sent by every ham in the world using CW in the last 80 years in just a few minutes. RF

Buying Used HF Gear

Caveat emptor.

by Jeff M. Gold AC4HF

The old Latin saying "caveat emptor" or "let the buyer beware" is important to keep in mind when you are buying used equipment. Being armed with good information can reduce the risks involved in buying used HF gear. Still, good deals are out there if you know what to look for. I own a number of HF rigs and they have all been purchased used.

What about the risks? Well, even if you buy new, the item can break immediately after you purchase it. Insurance in the buying game involves getting a warranty. Most new HF gear comes with a one-year manufacturer's warranty. Like car insurance, this peace of mind costs you hard cash. New equipment can be almost twice as expensive as a good deal on the same item used; however, if you want insurance when buying a used rig, it is a little harder to get.

Buying by Phone

Many of the major ham radio equipment dealers across the nation offer warranties on the used gear they sell. Some will offer 30-day warranties, some will even allow you to trade up to a new or more expensive rig within a given period of time and apply the full price you paid. This warranty has its price. Used gear from these dealers is typically going to be more expensive than if you purchased the same item from other sources. This may be an excellent way for new hams to go. Most of the dealers across the country have toll-free numbers, and you can compare prices and warranties very easily over the phone.

I purchased my first rig by phone. I looked in the back of several ham radio magazines and made a list of every toll-free number. I called weekly to see what used gear was available in my price range. I asked each dealer for advice about what I should purchase. I found that the knowledge, friendliness and patience of the salespeople varied. After a few weeks I started to get a feel for dealing on the phone. I identified a few of the older rigs that were in my price range and narrowed my inquiries to those I was interested in. I purchased from an outlet chain—I found one of their branches that had a good deal on an old Kenwood 820S with an external VFO and 500 Hz CW filter. I wanted a complete station with antenna, key, station log, plus some other items to complete my first shack, and had about $550 to spend. The items I wanted were located in different stores in their chain. I purchased all the items, with a warranty (and peace of mind), from one dealer. The items arrived from different parts of the country, all on the same day. Packages were lined up in my carport! I have had similar positive experiences with other stores I have located using toll-free numbers.

Buying from Local Hams

One of the safest ways to purchase a used rig may be from a local ham. He may have just purchased a new rig, want to purchase a new rig, or want to get out of the hobby (or so he thinks). Buying in this way, you can usually try the rig out and make sure it is functioning properly. Estate sales also often provide bargains.

Hamfests

One of the great ham pastimes is attending hamfests. These ham flea markets are a great source of bargains. There are many hamfests nationwide that vary in range from small local events to large international extravaganzas (such as the Dayton Hamvention). There are listings of many of these hamfests in ham radio magazines, including *Radio Fun*, and *73 Amateur Radio Today*. After attending hamfests for a few years I have found that each seems to have its own characteristics. Some hamfests never seem to have used HF gear, while others seem to have many pieces to choose from, year after year. As time approaches for a given hamfest, ask around or attend as many as you can. The disadvantage of buying at a hamfest is that you probably don't know the guy you are buying from and probably can't try the equipment before you buy it. The advantage is that you can pick up some great bargains. There is a strategy to bettering your chances at the good buys. If you are ready to buy, be there as early as possible.

If you find a bargain right off the bat and it is what you are looking for, haggle a little with the price, then buy it—it probably won't be there long. If you see a rig you want and the price is a little high, haggle a little to feel out the seller's price range. Check back about every hour and once in a while bargain a little more. If the rig isn't sold towards the end of the day you can often get a very good deal.

"If you find a bargain right off the bat and it is what you are looking for, haggle a little with the price, then buy it—it probably won't be there long."

It is a good idea to take along someone who has had experience buying used gear and knows what to look for. Also, when I buy at a hamfest I always get the callsign, name and address of the person I purchase the items from. If they won't give you this information don't buy from them. I have only had one negative experience where I was told something worked and it didn't. I had purchased the item at a good price, so even after replacing parts I still ended up with a bargain.

Internet

There are other sources for locating good deals on used gear. The Internet Usenet news group is one of the best. I hesitate to give up this closely-held secret. I have both bought and sold *many* pieces of equipment using this resource. For instance, I'm currently collecting old Ten-Tec HF gear and never would have located some items without this resource.

The Internet is a worldwide network that connects other regional computer networks. Educational institutions (grade school and up), non-profit organizations, commercial organizations and government agencies now have access to this resource. Easy low-cost ways to connect to the Internet are developing rapidly.

There is a news group on the Internet called *red.radio.swap* which is like a 2 meter BBS for buying and selling ham gear. People worldwide have access to this. New items are posted daily and sell rapidly.

Classified Ads

You can also locate used equipment in the pages of major ham magazines, but you've got to be quick. I have often found that by the time I got my magazine and called the number, the items had been sold. There are relatively few items for sale and a great number of people receiving these magazines. (This must be a fast way to sell!) Still, someone has to be first to call and get the item, so it is worth a try. There is also the *Ham Trader Yellow Sheets* (for a sample copy, send an SASE #10 envelope with two stamps to POB 2057, Glen Ellyn IL 60138). This is a publication that comes out twice monthly for the purpose of listing ham radio gear for sale.

Do Your Homework

The process I use when purchasing a used HF rig is to do my research as to what I am looking for, then start to use all the above resources in my search. I start to accumulate the data on the price range for the item I want, and then decide what I am willing to pay for it. The resources mentioned are good methods for determining price range.

Before you can get to this step, you need to decide which rig or rigs you are interested in. This is a part of the process that can strike terror in the hearts of both new and old hams. I have seen hams agonize for long periods of time trying to make a decision. They seek help from everywhere, trying to determine "the best rig for X amount of money." Well, it just doesn't work that way.

Buying an HF rig is like choosing a car. People will argue on and on about this one versus that one and why it is definitely the best. The truth is that people choose different cars because one looks better, one is more comfortable to them, one seems to handle better, one has more gadgets. HF rigs are very similar. Each ham operator has different likes, dislikes and operating styles. You need to find the rig or rigs that best meet your needs. Like buying a car, there are actual performance evaluations that professionals have done. Many times a certain used rig will be known to have a certain aspect that it was best or worst at. So how do you go about making an intelligent decision?

The key aspect in your search for the perfect rig is to clearly understand what it is you are looking for. The major parts of this decision are usually price, reliability, performance and features. The price part is easy. You determine the range of money you can beg, borrow or steal and you are done. The rest is the part that causes hams to toss and turn in the middle of the night with nightmares.

HF rigs are special animals. Hams often become very attached to their equipment, especially their first HF rigs. I have heard many a ham moaning over how he wished he had kept that first rig and actually made it a mission to find one just like the first one. I have heard more than one story about a ham at the end of the search cleaning off the rig, and while checking it over realizing that he had, in fact, ended up purchasing the rig he had sold a long time ago. Due to this special nature of the "first rig," hams often experience great anxiety during the selection process. Many hams such as myself didn't have Elmers to help them in the process. There are certain basic facts to keep in mind during the selection process that will help.

After you have made a decision as to your price range, the next step is to identify what features are important to you. This is the tough stuff. This is especially hard for a new ham who really doesn't have any idea what he really needs to be looking for; I know this firsthand. I am going to limit this article to radios that are at least mostly solid-state transceivers. This means only a few tubes will be found in the rig: the ones that provide the drive for the final amplifier tubes, and the final amplifier tubes themselves. There are many of these rigs available that work great and can be had at an affordable price.

There are some important differences between 100% solid-state rigs and ones that have tube finals. The hybrid rigs (with tube finals) usually sell for significantly less. I sold my Kenwood TS-820S for $350, and it was in mint condition. The hybrid rigs are much more tolerant of mismatches between an antenna and the rig (SWR). With a hybrid rig you will have to learn how to tune up the rig. This process isn't very hard and only takes a few moments when you get used to it. You need to do this when you change from one part of the band to another (CW-SSB) or when you change between bands. It is much like having a stick-shift car. Some people don't mind it at all, and may even prefer it. To some it becomes a nuisance. If the antenna is not resonant and presents a bad match to the rig, the tubes will not last anywhere as long as they should. This problem can easily be solved by using an antenna tuner. (I learned how to tune my rig quickly and didn't mind it at all.)

If you buy one of these rigs make sure replacement tubes are readily available. Many of the hybrids used the 6146B tubes. These tubes are still available used and new. I purchased sets of new tubes for about $14 at hamfests. You also need to watch out for the type of tubes you purchase. Kenwoods seem to have some problems when using new tubes sold that are manufactured in China. Penta and many other tubes are manufactured in China. After having some problems with a new set of tubes that were matched in power (a matched set is recommended when possible) I called Kenwood. They said that they had a record of some problems encountered with Chinese tubes and their rigs. That doesn't mean you can't use them, but you may want to locate American-made tubes.

100% solid-state rigs do not require tuning *the rig* between parts of the band or between bands. You will still need an antenna that is resonant, or an antenna tuner. These rigs are not tolerant of antenna mismatches and most have special circuitry that will reduce their output power if a mismatch exists. When my eight-year-old son earned his General license, I decided it was time for a 100% solid-state rig so that he could operate solo when I wasn't around.

The next consideration is what bands the desired rig should cover. Some of the older rigs do not have the newer WARC bands (12, 17, 30). My 820 did not cover these and I didn't even know the difference when I was first licensed. There is plenty to do on the rest of the bands, especially if you are a new ham. You may want to take this into consideration if you have the extra money. These bands do not allow contesting, and each has its own personality. I have not worked 12 much, but

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Please write to us! Tell us what you've been doing, what you think of ham radio, and what you like or don't like about *Radio Fun*. If we publish your letter, you'll get a free one-year subscription (or extension) to *Radio Fun*. Send your letters to us at the address above, or fax us at (603) 924-9327. Be sure to type or print legibly, and include your full name, callsign, and complete address.

Dan Eastlick KB7VQP, Olalla WA Wayne, after reading your May "QLF" and noticing your extra grumpiness in the first paragraph, I decided to write and give you my perspective as a new ham, how I feel about amateur radio and how I think more people will get involved in our interesting hobby.

Many Operators are Boring Radioheads or Jerks: Ninety percent of the time when making a new contact I end up talking to a walking and talking radiohead with very little interest in anything other than my antenna and watts, or a "know-it-all" pain in the ass who I'd like to smack and say, "Hey, I'm a new ham, not stupid." I have interesting radio *friends* who are totally off the grid, interested in NW exotic ferns, have an interesting line of work at the nearby shipyard, or are very proud of their children and tell me what they are up to. It's always a pleasure talking with these people because you can laugh, have serious discussions, and debate local and national issues. You can't do that with boring radioheads or jerks because the radiohead's only stimulating reading is *QST* and the jerk's opinion is G_d's honest truth without rebuttal.

Next time ask someone what they do for a living, what's their hobby, or what's new. I'll tell you I just came home from fishing in Wyoming on a reservoir 7,000 feet high. Or I might tell you that I'm a volunteer firefighter and have been in a controlled burn where the temperature reached 1200 degrees, or tell you what I do as a reserve Captain in the Air Force. Maybe if you asked we might have similar experiences or interests; I'd love to hear about them.

The ARRL Breeds Ignorance: I would like to spend hours building a great radio and I, like many other people, have sought assistance from ARRL publications to accomplish this endeavor. Almost everything you can build out of ARRL magazines and books are beyond technically extinct. To prove it, check out how many radios require air-variable caps as tuning devices. How many of those caps do you see at your local Radio Shack or electronic supply store? I don't want to spend my time sorting through ham swapmeet refuse (and possibly meeting more jerks or boring radioheads) for a 100 pF air-variable cap. Is industry using these caps? Hell no, at least not since the 1970s. There are methods of tuning that are far more accurate and less expensive. In case any readers are in the same dilemma, voltage-variable caps/diodes, certain RF chips (MC3362/3, etc.) and microprocessor tuning seem to work well with radio manufacturers. Why can't we use them in our home-brews?

I also don't want to build a CW-only radio. I had to purchase three ARRL books before I found one plan for an SSB driver for which parts were still available. Now I have to figure out how to add all this together to build a half-decent CW/SSB radio with parts that will be around for a while. I've basically given up on getting help and have had to try to go it alone; maybe I'll be a better man for it.

Some Simple Solutions:

1. Shut up and really listen when being spoken to.
2. Be exciting to talk to, share life experiences.
3. Stay current on technology, share a new design with a friend or two.
4. Really help someone if they need it, don't try to confuse them or impress them with your expertise to satisfy your own ego.
5. Be courteous and patient with newcomers, keep your attitude off the air.
6. Old-timers: Mentor a new ham. The new ham will be grateful and you will have left a legacy.
7. Form a group and build a radio just beyond your present individual capabilities.
8. Try to make friends, not contacts.

Robert L. Larson W7LNG, Medford OR Wayne, I read all your editorials, both in *Radio Fun* and *73*. I don't always agree with you but you get the brain working. If all the good ideas we come up with were developed I'm sure we could improve the world in some small way (maybe even in a large way).

I would like to encourage newcomers to think of the code as fun, not a big barrier to HF operation. Having started in ham radio as a teen-ager, when I dreamed of having a big station that would command attention on the bands, I was content to start with a 6L6 crystal oscillator transmitter from the *How to Become a Radio Amateur* ARRL booklet. I'm sure that practicing copying CW on simple equipment helps the mind separate signals in pileups.

Building is actually a lot easier now but the small parts get lost on my workbench. Simple kits and printed circuit boards hurry the project along. (See *Radio Fun*'s "Flea Market" for sources.) I still remember the thrill of the New Zealand QSO with my rock-bound 20 watt signal on 40 meter CW over 45 years ago. The two-tube regenerative receiver brought ZL2MM's signal in loud enough for my 15-year-old ears to hear fine! Operating a modern digital transceiver is not as exciting as using a rig made by your own two hands.

Peter Pitt, St. John, New Brunswick, Canada When my first copy of *Radio Fun* arrived the first article I read was "QLF" by Wayne Green—"All This Whining Over the Damned Code!" (June 1994). The second was "Starting an Amateur Radio Club"; next was "Ham Marketplace." I am now writing to the advertisers, in preparation for ordering my first transceiver. You see, I am a DXer-shortwave listener, and your *Radio Fun* has everything for this new hobbyist, about to be a new Senior (57 years old) ham radio enthusiast. I would like to compliment you on putting out a publication that the amateur can understand and get something out of. I will be ordering Wayne Green W2NSD/1 code tapes, several books from Electronics Book Club, and equipment from *Radio Fun*'s Ham Marketplace.

P.S.: I just started reading "Emergency Communications" by Peter A. Bergman NØBLX—just great for a DXer like me starting to study radio for the first time. Keep up the good work. I hope to be a long-time subscriber. RF

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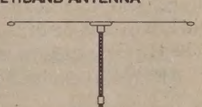

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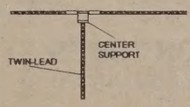

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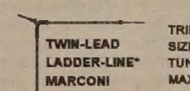

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Buying Used HF Gear

Continued from page 4

it behaves a lot like 10 meters. 17 meters is a lot like 20 meters. There is some good DX on this band and people tend to chat more rather than just issue signal reports. You can also operate CW, digital and SSB on this band. 30 meters is a CW and digital band only. When it is open and not real noisy it is a great CW band for sitting around and rag-chewing.

Another consideration is, what modes does the rig offer? Does it have CW, SSB, FM, AM, FSK? Whether or not these are important depends on what you plan to operate. I have only used FM repeaters a few times. You can operate machines such as the Virgin Island Repeater and have a lot of fun. When 10 meters is open you can work all over the world in the same manner as you do locally with a 2 meter repeater. I have only worked AM once with a friend and may never work it again.

CW and SSB are usually the two modes that most new hams are interested in. Most hybrid and solid-state rigs are capable of operating the digital modes such as RTTY, AMTOR and PACTOR. I was very successful with my 820 on the digital modes. If you plan on using a solid-state rig on the digital modes you have to make sure it has 100% duty cycle. This means that it won't hurt the rig to be in the transmit modes for longer periods of time. You should also consider which modes the rig is better at working. If you operate mostly SSB and the one weakness of the rig you are considering is that it is not that great a CW rig, it may not matter. If you operate mostly CW and you have read a review that says the rig is OK as an SSB rig but not great, who cares. You may also need to choose between an analog and digital display. The digital will be much easier to read, but to many it is just a convenience.

The things that your transceiver needs to be able to do are to transmit and receive and switch between the two. The ways the rigs handle these functions are what makes each rig different. The receiver needs to be able to "hear" the signal. The ability of a receiver to hear weak signals is called sensitivity. It also needs to separate the desired signal from other signals, which is termed "selectivity." Its ability to filter out unwanted noise may depend on the type of built-in and optional filtering methods it has. The transmitter needs to be able to transmit a signal over the airwaves at a certain power level cleanly without creating unwanted emissions.

The receivers incorporate features that improve the way you can tune to the signal of the person you want to speak to and get rid of all other signals and noise. One helpful feature is Receive Incremental Tuning (RIT). This feature allows you to tune the receiver a small amount without changing the transmit frequency. This sometimes allows you to copy a station when another station is close by and interfering. Intermediate Frequency Shift or Passband Tuning (IF or PT) is another method to reduce interference. Variable bandwidth tuning (VBT) adjusts the receive bandwidth and allows you to adjust for varied band conditions. A Notch Filter cuts the strength of an interfering signal to help "notch" it out. These methods all work on the radio frequency signal (RF). Many receivers have optional IF crystal filters. These are made for either CW or SSB and can be very effective in crowded band conditions. An SSB filter is typically 2100-2700 Hz. A CW filter can be from 250-600 Hz. The 500 Hz is probably the most popular because the 250 Hz filter can be too narrow for many operators—they find it hard to tune in stations. If you are planning on operating mobile, a noise blanker is almost essential. The noise blanker is designed to help filter out interference from the vehicle's ignition system.

> ***"The key aspect in your search for the perfect rig is to clearly understand what it is you are looking for. The major parts of this decision are usually price, reliability, performance and features."***

Audio filters that can work for both CW and SSB can make the difference between having a QSO and not being able to copy a station through interference. Audio filters work with the signal after it has been changed from RF to audio. This is a less expensive filtering method.

Filters can many times be combined with each other to provide very effective noise fighting. When I look for a CW rig it must have at least some good filtering capabilities. I prefer a 500 Hz crystal filter and maybe some type of audio filtering. Some rigs also offer built-in variable speed keyers and a choice between full or semi break-in (QSK).

When operating SSB, features such as speech processing may become important. This feature may allow your SSB signal to get through better when working DX or in adverse band conditions. If you are planning on working a lot of DX you may need the rig to be able to do split operation. Some DX stations transmit their CQ on one frequency and listen for responses on a set of other frequencies. Modern rigs handle this by having dual built-in VFOs or tunable memories. With older rigs you can often find an optional external VFO. Another feature that many hams desire is a General Coverage Receiver. This type of receiver allows you to receive shortwave and other broadcasts.

You will need to have DC rather than AC power to make your transceiver work. The two ways the manufacturers handle this are by either building a power supply into the rig, or requiring a separate supply. If you're looking at separate supplies, make sure that they are well regulated and filtered (give the right voltage and don't inject any undesired noise into the rig.) You should also look at the *continuous* amperage rating of the supply, not just the *peak*. When operating CW or the digital modes, it becomes important to have the supply be able to handle the demand over a longer period of time. Some major manufacturers call their products "20 amp" supplies. This may mean that they are capable of 20 amps for a short burst but may only be capable of 16 amps continuous duty.

I have a few more suggestions for the pre-shopping stages of this adventure. If possible, go to a chain store, friend's house, or wherever, and try out as many different rigs in your price range as possible. See what you like and don't like. This may not be possible, but it's worth a try. Bring a knowledgeable ham who knows which buttons and knobs to play with. While testing the rig, check out as many of the modes as possible on both transmit and receive. The receiver is the more important part of the rig. "If you can't hear him, you can't work him." See how the receiver performs under crowded and noisy conditions. Contest weekends provide some really challenging conditions in which to test out a receiver's ability tosingle out a signal.

Check the rig or ask if it has been modified. If you don't like messing with the insides of ham gear you may want to avoid modified rigs. Older Yaesus, such as the FT-101 and FT-102, many times have been modified for use as CB radios. Find out if the person or dealer has the manual and schematics. See if you can find out whether replacement parts are still available and whether the manufacturer or third parties will still repair the rig if necessary. If the rig doesn't have an accessory that you want, see if there are any third parties who sell the item. Check with hams you know and see if the rig had any unusual problems. I found out that Kenwood 820Ss with digital displays are known to have problems with the display going bad. Right after I read about the problem, mine went bad. It turned out it wasn't hard to fix and I was able to do it myself.

You have been very patient; what you really want me to do is tell you which rigs to look for in each of the price categories. Each of you has different preferences and different operating styles. I recommend that you identify your needs and wants in an HF transceiver, then read the reviews that were published about them in the major ham magazines. *Radio Fun* reprints "Vintage Reviews" from *73* for this very purpose. You should find that there will be a number of good choices in each price range.

Resources

I have spent many hours in the past doing research on good buys in used rigs. In my research for this article I identified an excellent resource to make this task easier. The ARRL publishes two books that are well worth the money. The first is the ARRL's *Radio Buyers Sourcebook*. This book provides much of the information I left out and more detailed explanations of filtering methods and things to look for when you buy an HF rig. The first chapter has information on what transceiver features to look for. The second chapter is a compilation of *QST* reviews on many rigs from the four major ham manufacturers that cover the time period I recommend (Kenwood 520/820 hybrid type rigs), up to about 1991. The book covers UHF/VHF equipment. The end of the book has information on power amplifiers and accessories. There are appendices that provide the information on equipment service and parts addresses, sources of manuals, and a chart that compares performance.

You are now armed with enough information to start on the exciting pursuit of your own used HF rig. Don't drive yourself crazy—there are many correct solutions for this puzzle. Once you have done your homework and put your transceiver on the air you will almost certainly grow to love it. If you find, after a period of time, that various features are essential to your operating style, it will give you an excuse to start your search all over again. RF

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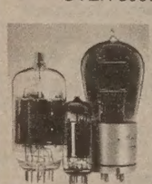

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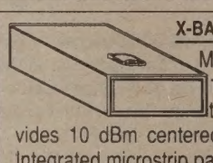

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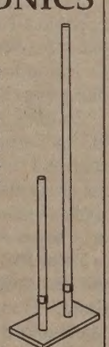

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Car RADAR Systems Coming

According to a report in *Electronic Engineering Times*, defense contractors are speeding up efforts to get practical RADAR systems in automobiles by 1997 or 1998. The report says experts at both TRW and some GM-Hughes subsidiaries are shrinking high frequency GaAs circuits for use in cars.

The RADAR systems are seen as a first step toward an intelligent-vehicle highway system, using RADAR to help drivers navigate and avoid traffic jams. The systems are also seen as safety devices which, when combined with cruise control and alarm systems, can help to avoid vehicle collisions.

The cost to automakers is still too high; experts say price tags in the $200 range will be necessary before the plan can succeed. The program could create a large market for GaAs chips developed in the government's MMIC program. *TNX Electronic Engineering Times, June 27, 1994.*

Majority Call Ham Radio Valuable

H.J. Res. 199, the Joint Resolution recognizing the Amateur Radio Service, now has a majority of the U.S. House of Representatives as cosponsors. On April 11th, four additions to the list of cosponsors brought the list total to 220 (of which three are non-voting delegates). The four are Rep. James Talent (R-MO), Del. Eleanor Holmes Norton (D-DC), Rep. Thomas Ridge (R-PA), and Rep. Don Young (R-AK).

The resolution seeks formal recognition of the value of amateur radio to the country. It would support amateur radio as "national policy." It would also encourage rules and regulations to facilitate amateur radio as a public benefit by encouraging new technologies. There are now 218 voting sponsors, including Resolution sponsor Jim Cooper (D-TN). There are currently 434 Representatives in the House. *TNX Westlink Report, No. 673, June 6, 1994.*

Let Market Forces Decide

FCC Chairman Reed Hundt said his agency's goal in devising rules for auctioning the airwaves for new communications devices later this year is to let market forces decide who will conduct business profitably within that spectrum. Hundt said the commission will not limit the number of licenses that result from the bidding for that spectrum, nor will it prevent a licensee from piecing together spectrum to reach a big geographic area.

Speaking before the Harvard Business School Club of Greater New York, Hundt stressed the need for greater competition in telecommunications, at times defending the FCC's recent regulatory actions as laying groundwork for greater competition.

The FCC plans to auction spectrum for a new breed of wireless communications. This summer it is to begin auctioning spectrum for narrowband wireless communications such as paging. Later this year it plans to auction spectrum for transmitting broadband wireless signals—from phone calls to video images. *TNX Westlink Report, No. 673, June 6, 1994.*

10 WPM Generals?

"Slow-code" is the name given to an Amateur Radio Industry Association proposal to lower the General Class code speed requirement to 10 words per minute. So far, it has gained far more support than criticism in ham radio circles. Most of the packet radio postings on slow-code praise the industry group's leadership. Some even say 10 WPM doesn't go far enough, with 5 WPM being suggested instead.

Slow-code is also getting support from users of various public bulletin boards. An unofficial poll being conducted by Newsline is so far five-to-one in favor of the Amateur Radio Industry Association's slow-code proposal.

The association has yet to announce a firm date for filing its slow-code rule making request before the FCC. *TNX Westlink Report, No. 673, June 6, 1994.*

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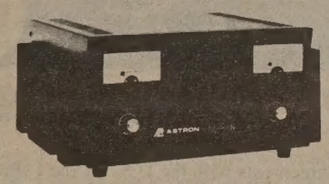

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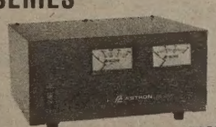
RM-35M	25	35	5¼ × 19 × 12½	38
RM-50M	37	50	5¼ × 19 × 12½	50
RM-60M	50	55	7 × 19 × 12½	60

RS-A SERIES

MODEL RS-7A

MODEL	Colors Gray	Colors Black	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H × W × D	Shipping Wt. (lbs.)
RS-3A		•	2.5	3	3 × 4¾ × 5¾	4
RS-4A	•	•	3	4	3¾ × 6½ × 9	5
RS-5A		•	4	5	3½ × 6⅛ × 7¼	7
RS-7A	•	•	5	7	3¾ × 6½ × 9	9
RS-7B	•	•	5	7	4 × 7½ × 10¾	10
RS-10A	•	•	7.5	10	4 × 7½ × 10¾	11
RS-12A	•	•	9	12	4½ × 8 × 9	13
RS-12B		•	9	12	4 × 7½ × 10¾	13
RS-20A	•	•	16	20	5 × 9 × 10½	18
RS-35A	•	•	25	35	5 × 11 × 11	27
RS-50A	•		37	50	6 × 13¾ × 11	46
RS-70A	•		57	70	6 × 13¾ × 12⅛	48

RS-M SERIES



MODEL RS-35M

MODEL	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H × W × D	Shipping Wt. (lbs.)
• Switchable volt and Amp meter				
RS-12M	9	12	4½ × 8 × 9	13
• Separate volt and Amp meters				
RS-20M	16	20	5 × 9 × 10½	18
RS-35M	25	35	5 × 11 × 11	27
RS-50M	37	50	6 × 13¾ × 11	46
RS-70M	57	70	6 × 13¾ × 12⅛	48

VS-M AND VRM-M SERIES

MODEL VS-35M

• Separate Volt and Amp Meters • Output Voltage adjustable from 2-15 volts • Current limit adjustable from 1.5 amps to Full Load

MODEL	Continuous Duty (Amps) @13.8VDC	@10VDC	@5VDC	ICS* (Amps) @13.8V	Size (IN) H × W × D	Shipping Wt. (lbs.)
VS-12M	9	5	2	12	4½ × 8 × 9	13
VS-20M	16	9	4	20	5 × 9 × 10½	20
VS-35M	25	15	7	35	5 × 11 × 11	29
VS-50M	37	22	10	50	6 × 13¾ × 11	46
• Variable rack mount power supplies						
VRM-35M	25	15	7	35	5¼ × 19 × 12½	38
VRM-50M	37	22	10	50	5¼ × 19 × 12½	50

RS-S SERIES

MODEL RS-12S

• Built in speaker

MODEL	Colors Gray	Colors Black	Continuous Duty (Amps)	ICS* Amps	Size (IN) H × W × D	Shipping Wt. (lbs.)
RS-7S	•	•	5	7	4 × 7½ × 10¾	10
RS-10S	•	•	7.5	10	4 × 7½ × 10¾	12
RS-12S	•	•	9	12	4½ × 8 × 9	13
RS-20S	•	•	16	20	5 × 9 × 10½	18
SL-11S	•	•	7	11	2¾ x 7⅝ x 9¾	12

*ICS—Intermittent Communication Service (50% Duty Cycle 5min. on 5 min. off)

CIRCLE 16 ON READER SERVICE CARD

JOTA, JOTA

Just add jing, jing, jing.

by Linden Scott Hall KAØDAQ

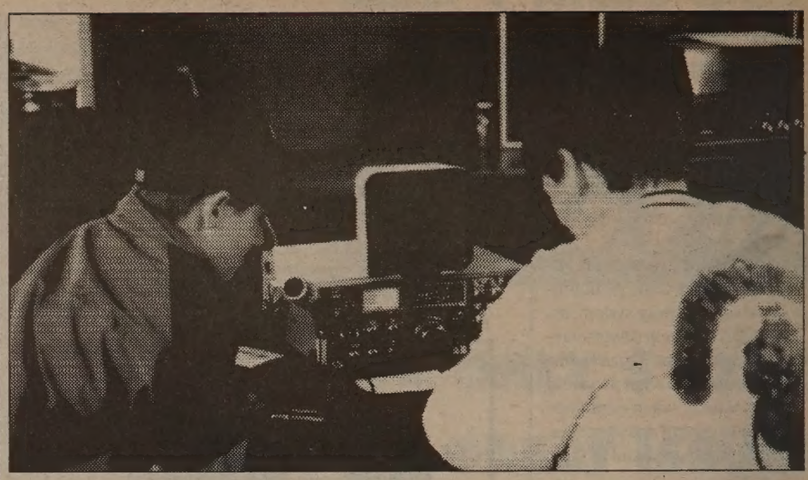


Photo A. Left to right: Arik Anderson, Dave Kellner KGØCV: Scout to Scout over the air.

Is this too old a song reference? Anyway, JOTA stands for Jamboree On The Air. It's sponsored by the World Bureau of the World Organization For The Scouting Movement. My dictionary states that a "Jamboree" is a noisy celebration or a large gathering; JOTA is both in spades.

If you've been reading Wayne's editorials you know he's always talking about getting more young people into this hobby of ours. JOTA is just the way to do it—it's painless, even fun.

The idea is to get Scouts, both Girl and Boy Scouts, on the air to talk to other Scouts across the country and around the world. This has been going on since 1958. This October 15 and 16 will be the 37th annual, with as many as 300,000 participants and more than 100 countries on the air over the weekend.

I've been involved with JOTA for the past three years. Each year more Scouts are introduced to ham radio. I started with only my son's Webelos den, and the next year added a few Boy Scouts. With the help of the Saint Cloud Amateur Radio Club last year we hosted 63 Scouts with their leaders and parents.

This last year was a tough one. We started out with a power outage in the wee hours, causing alarm clock foul-ups and a late start. All morning we had fog so thick it made driving hazardous. Not all the equipment planned on showed up, including the portable beam I had counted on. All three operators, Jerry Hardwig WBØWEN, Dave Kellner KGØCV and Jack Maus WØMBD, had their hands full with crowded bands and only a vertical antenna. Still, the club did a great job. All the Scouts had a great time for the six hours we operated. You can do it too. Come on—join in! It's a great time.

It's Easy

You don't have to go whole hog—it can be simple and easy. First you need a Scout or two. Start with your kids or grandkids if they're Scouts. Ask at church and at the local school, they might sponsor a troop. Remember, any Scout can join in the fun: Cubs, Brownies, Tigers, Daisies, Explorers, Boy Scouts, Girl Scouts and Girl Guides. This includes former Scouters and leaders.

You already have the equipment, license and a place. If it's just a couple of kids there should be no problem. However, your spouse may not want a whole troop of little kids taking over your home, sweet home. Consider operating portable to accommodate more people and to save wear and tear on the furniture.

Operating will go easier if you do two things first: Explain what's going to happen and have them make a script card.

First, gather the Scouts around the radio and spell out the rules (no shouting, one person talks at a time, no grabbing the microphone, etc.). Give a brief outline of what they're going to try. Listen to a few QSOs and explain the ham jargon. Listen again and chart a few QTHs. Point out that they aren't just saying "hello." Ask what questions they want to ask.

Next, have each Scout and his or her leader make out a script card: an index card with their name, city, state and unit number (pack, troop, post). Add a topic to the card, a favorite sport or video game, book or movie, their latest Scout activity. I typed up a card in "Fill in the Blank" style and photocopied enough for all the Scouts.

As with everything, there are some rules. For more detail and some program ideas, write too: Jamboree On The Air-S221, Boy Scouts of America, 1325 West Walnut Hill Lane, P.O. Box 152079, Irving TX 75015-2079. Enclose a stamped self-addressed envelope. Ask for "More About JOTA."

The Rules

1. All FCC rules and regulations must be followed. Have a list handy of countries with third-party agreements with the U.S. (or the country you're operating from).

2. Call or answer "CQ Jamboree" or "CQ JOTA."

3. Any band, any mode. Talk your club into doing something impressive. Demonstrate CW, VHF, packet, OSCAR, ATV or maybe foxhunting.

4. JOTA is not a contest! No logs are sent in, no scores and no multipliers. The idea is to introduce Scouts to ham radio and let them talk to other Scouts, not just exchange of signal reports.

This is what it all boils down to: You (the ham) invite Scouts into your shack (or portable location). Make a contact with other Scouts. Let each Scout take a turn at the microphone. Have them fill out a QSL card and add a note. The end. All you have to do is play host operator.

JOTA is a great way to introduce kids to ham radio. Scouts are not your average kids; they're motivated, they're interested, they're active. Give your demo some of that old jing, jing, jing. After each has had a turn at the mike ask if they want to try another QSO. If the answer is yes, look out. They might want to work some DX. They might want to play all day. They might start looking at you with a little admiration. Can you handle it? RF

Everything You Need To Know About JOTA

October 15 and 16, 1994.

Operating time: Anytime you hear "CQ JOTA," or during the 48 hours of the weekend, Saturday and Sunday.

Calling frequency, CW in MHz: 3.590, 7.030, 14.070, 18.080, 21.140, 24.910 28.190.

Phone, in MHz: 3.740, 3,940, 7.290, 14.290, 18.140, 21.360, 24.960, 28.350, 28.990.

Photo C. Left to right: Dave Kellner KGØCV, Adam Springer, John Seliski, John Wilder and Mike Matsuura lining up for a turn at the microphone. All Scouts are from Troop 106, and Cubs from Pack 106.

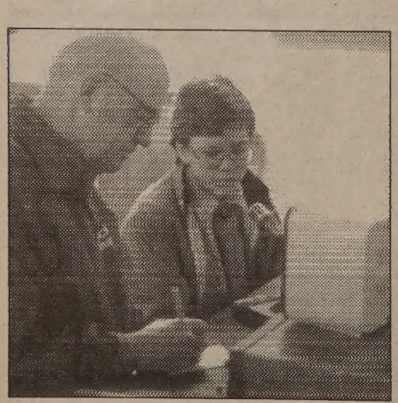


Photo B. Jack Maus WBØMBD and Peter Nei logging contacts.

Photo D. Making script cards. Front, left to right: Dave Wilder, Scott Hall; background: Jerry Hardwig WBØWEW. The kids: Rocky Seifert, John Wilder, Adam Springer, Mike Matsuura.

Photo E. Jerry Hardwig WBØWEW and Dave Kellner KGØCV setting up a trap vertical behind the Troop 20 building.

RF review

Ten-Tec
1185 Dolly Parton Parkway
Sevierville TN 37862
Telephone: (800) 833-7373
Fax: (615) 428-4483
Price Class: $549 includes one band module; $29 each add'l band module

The Ten-Tec Scout

Easy, affordable and best of all, fun!

by Michael Bryce WB8VGE

Since the introduction of the microprocessor into ham radio we've seen the size of our transceivers go down. At the same time, we also have seen the complexity of their operation go through the roof. Is there an affordable blend of microprocessor technology and simple easy-to-use circuitry available?

Well, yes there is. It's called the Scout and it's made by the folks at Ten-Tec. Ten-Tec calls it their model 555. The Scout is a small transceiver with a microprocessor mated with time-proven analog circuits. The entire package is affordable, even for the ham with a slim budget. And talk about easy to use! Getting on the air when you're new to ham radio can sometimes be a real Maalox moment. That's not the case with the Scout. It's made to be simple to use, and that's especially pleasing to the new ham. Old-timers will like the ease of use, too.

The receiver has a superhet design using an IF of 6.144 MHz. The Scout's superhet receiver is single-conversion. Receiver sensitivity is 0.35 µV for 10 dB @ 2.5 kHz bandwidth. The dynamic range is 85 dB @ 2.5 kHz bandwidth.

Monoband operation with plug-in modules allows you to cover all the ham bands—that's operation from 160 meters through 10 meters. There is some overshoot on all bands. A large 0.56" four-digit LED display has 100 Hz resolution. The actual transmitted CW signal is 750 Hz below the display frequency on 160, 80, 40 and 30 meters. The transmitted CW frequency is 750 Hz above the displayed frequency on the higher bands. The display will show you the receive signal's frequency, minus the MHz digit. That digit is printed on the front of each module. The microprocessor has no control over the output of the VFO, except for the Frequency Lock System, or FLS. The microprocessor adds features to the Scout, while analog circuits provide the muscle.

The optional noise blanker takes care of ignition noise while you're hamming down the road. The patented "Jones" filter is front-panel-adjustable from 500 Hz to 2.5 kHz. Full CW QSK, a Ten-Tec tradition, and push-to-talk SSB round out the features.

The Scout provides a solid 50 watts of RF output to the antenna while drawing a scant 10 amps from a 13.8 volt power supply. If the cigar lighter in your automobile will handle the current (some of them won't), you can power the Scout directly from it. On receive, the Scout requires 600 mA. The Scout can be tilted up by the bail handle. The entire package weighs in at only 5 lb. 3 oz.

Photo B. A band module. One module of your choice comes with the rig.

A Closer Look at the Scout

The Scout is a mix of both old technology and the high-tech stuff of today. The VFO used by the Scout is a permeability-tuned oscillator, or PTO. Ten-Tec has been using these for years in their many transceivers, such as the Argosy line and the Corsair line. This time around the Scout has a new wrinkle, the Frequency Lock System.

The Scout uses a *RISC*, or Reduced Instruction Set Computer, to control several main functions of the Scout. It takes care of the LED display, and emulates a Curtis type B iambic keyer with adjustable speed from 5 to 50 wpm. You can tell Ten-Tec has always been a CW operator's rig; the default speed is 25 wpm. When you put the SPEED-RIT switch in the speed position, the current keyer speed comes out on the display. To change the speed, you hit the DAH paddle to decrease speed or hit the DIT paddle to increase the speed. The speed changes one word per minute for each dit or dah. Since there is no internal back-up battery, any speed changes will be lost at power down and the speed will be reset at 25 wpm every time you turn on the Scout.

Photo A. The Ten-Tec Scout. Simple, affordable and fun.

The Frequency Lock System

The largest task for the computer is the FLS. The Frequency Lock System is complex, so I'll try and explain it in as simple a concept as I can.

The main VFO is a permeability-tuned oscillator, or PTO. The oscillator covers 2.2 to 2.7 MHz, with some overlapping on the band edges.

When you finish tuning a signal, the microprocessor waits for approximately two seconds before allowing the system to lock. This allows the operator to make fine adjustments to the frequency without the microprocessor thinking it's drifting, and correcting. The frequency reading is then stored in a register for reference. The microprocessor compares each new reading with the reference reading, and if the difference is in excess of a preset amount it automatically corrects the PTO by means of a varactor diode. The theoretical stability is to +/- 10 Hz, compared with the frequency counter reading.

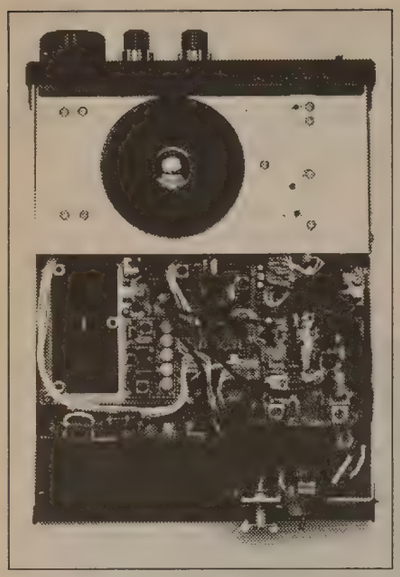


Photo C. Inside view of the Scout. The noise blanker is not installed in the unit. Notice the PA and its heat sink mounted out of harm's way.

Since RIT is used intentionally to make small frequency corrections, a circuit was added to detect any movement of the RIT control and shut off the lock feature. This is indicated in the display by the righthand decimal point being lit when the system is not locked.

The maximum amount of drift correction is approximately +/- 600 Hz. The drift correction system is reset when any tuning is done or if the power is turned off and then back on.

If frequency drift is within 10 Hz of the previous reading, there is no correction. If it is greater than 10 Hz but less than 40 Hz, the microprocessor will correct. Readings are taken every 200 ms. If the reading is outside the +/- 40 Hz window, the microprocessor assumes you are tuning and will reset the window.

In SSB transmit, the frequency correction works as it does in receive. CW operation is more complex. If the internal keyer is being used, it will take preference over any other operation. There will be no correction during CW transmit but, since it is a QSK system, corrections are made between characters, words and any other pauses. To minimize error when transmitting CW, the correction window is increased from +/- 40 Hz to +/- 100 Hz. When the transmission is over, the frequency is compared to the reference, and if less than 100 Hz, is corrected. After the correction, the window is reset to the +/- 40 Hz value.

The Manual

Ten-Tec has always had great manuals with all of their products. The manual for the Scout is no exception. It contains a description of every control and every jack on the rig. A complete circuit description of each and every module making up the Scout is also inside the manual. This is very handy for fixing the rig should the need arise. What? Fix your own rig? Yes, it is very possible and easier than you think. If you have a problem with the Scout, a phone call to Ten-Tec's service department may be able to step you through to find a bad board. Ten-Tec will send you a replacement board in exchange for your defective board on a 30-day billing invoice. You remove the suspect board and return it to Ten-Tec for full credit. If that won't fix the problem, then send the complete unit to Ten-Tec. Their service is legendary.

Using the Scout On The Air

When you first look at the Scout, you'll notice something strange: The lack of control knobs! Best of all, you don't have to wade through several displays of menus either. That's because the Scout is built to be simple to use! If you already have an antenna up, and a source of power, you can have the Scout up and running in as little as five minutes.

There is no band switch. To change a band, you remove the band module and replace it with another one. Just like that, your monobander just changed bands. I did not see any explanation in the manual about powering down to change the band modules, but it would be a good idea. On the other hand, I've just pulled one out and swapped in another one with the power on. Nothing happened, so I guess it's all right to do. There is a small lever on each module so you can pull it out of the case. Of course, the module mounts up front, next to the display.

"If you already have an antenna up, and a source of power, you can have the Scout up and running in as little as five minutes."

The modules contain the low-pass filters for their particular band and the mixer/crystal oscillator to convert the PTO to the correct local oscillator frequency. There is also a 3 MHz low-pass filter in each module to keep the 50 watts of RF out of the PTO circuits. A coaxial jack and plug arrangement route the RF in and out, while an edge-card-type plug and jack connect the rest of the circuitry to the Scout. Each module is about the size of a pack of cigarettes. One module of your choice comes with the Scout. Extra modules are $25 each.

You'll need a power source capable of at least 10 amps to fire up the Scout. Ten-Tec makes two different power supplies for the Scout in case you don't have one: A linear model and a high-efficiency switcher weighing only three pounds.

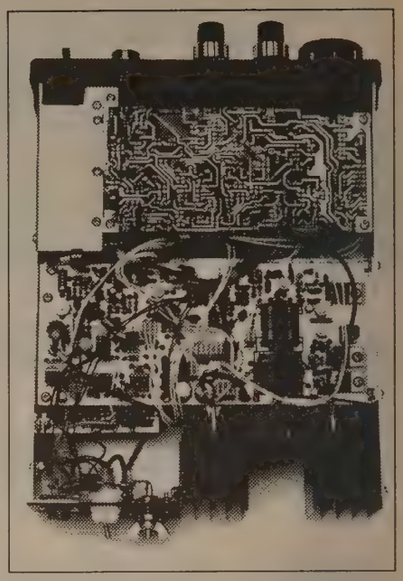


Photo D. Bottom view showing the low-level state and PA.

A standard SO-239 antenna socket is used to connect your antenna to the Scout. The analog meter measures RF power and SWR. You flip a switch on the back of the Scout to read SWR, otherwise you set it to read forward power. The tune switch places the rig in transmit and reduces the RF output to 15 watts. You don't need to worry about calibrating the meter, it's done for you automatically.

You tune the Scout with the main tuning knob. The tuning is stiff, *and it's supposed to be that way*. You're moving a slug in and out of a coil. You won't find a finger spinner hole on this knob. The stiffness is kinda nice when

Serving the LORD Since 1987

$49.95!

THE POWER STATION

The POWER STATION is a 12V x 7 AmpHr gel-cell battery complete with voltmeter, wall charger and a cord for charging via automobiles. It will power most HT's at 5 Watts for 2-4 weeks (depending upon how long-winded you are). Also VHF, UHF, QRP, or HF mobiles such as the KENWOOD TS-50 (at 50W). There are no hidden costs, all you need is your mobile, HT power cord or cigarette lighter adapter.

The POWER STATION provides 12V from a cigarette plug and has two recessed terminals for hardwiring. A mini-phone jack with regulated 3V, 6V, or 9V output can be used separately for CD players, Walkmans, etc. THE POWER STATION can be charged in an automobile in only 3 hours, or in the home in 8 hours. The charger will automatically shut off when the battery is completely charged, so you can charge it even when it has only been slightly discharged, (unlike Ni-Cads that have memory). Our charging circuit uses voltage sensing circuitry, other brands are timed chargers which always charge the battery a full cycle, this damages their battery and shortens its' life if it only needs a partial charge. The POWER STATION has a voltmeter that shows the exact state of charge of the battery, not worthless idiot lights that tell you "YOUR BATTERY IS NOW DEAD." The voltmeter can even be used to measure voltages of other sources.

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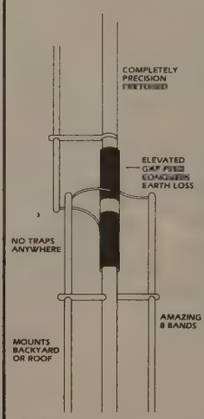
CIRCLE 364 ON READER SERVICE CARD

THE ANSWER IS GAP TECHNOLOGY • THE ANSWER IS GAP TECHNOLOGY

Q An Antenna with No Earth Loss?

A Yes... the answer is GAP'S revolutionary technology.



If you're looking for an antenna that can out perform the others and give you the edge, you're looking for a **GAP.** The Challenger DX-VIII is the revolutionary design that answers your demands for multi-band operation and unequaled efficiency with low noise. This is the technology that eliminates Earth Loss. **GAP** delivers from an elevated feed; your power doesn't disappear into the ground. Put it up. Turn it on. No tuning. No frustration. **GAP** delivers everything but the hassles. And — **GAP** delivers at a fraction of the cost of the "so-called" competition.

The Challenger DX-VIII
80m 40m 20m 15m 12m 10m 6m 2m

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GAP gets it all out.

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THE ANSWER IS GAP TECHNOLOGY • THE ANSWER IS GAP TECHNOLOGY

bouncing around mobile—the VFO won't be accidentally bounced off frequency by a rough ride. There are no memories to mess with or dual VFOs to get you into trouble (like operating out of band as so many of us did awhile back).

Of course, you can turn the RIT on (the RIT has +/- 1 kHz of range) and fine-tune a station, and you can use the variable bandwidth filter to cut out QRM. This is especially helpful during CW. You can set the Jones filter to just the right amount of filtering required by band conditions. There is no RF gain control on the Scout. There's plenty of receive audio from the Scout, even with its small internal speaker. You can use an external speaker or headphones, too. A front panel 1/4" stereo jack allows you to use your walkthing headphones with the Scout. To use my mono headphone with the Scout I had to insert the plug halfway to cut off the internal speaker, or all the way to have audio in both the internal speaker and headphones at the same time.

There is no sideband select switch either. That's done for you automatically. The Scout selects lower sideband on 160 through 40 meters and upper sideband on the rest of the bands.

If you want to operate CW you close your key, or you can use the built-in keyer. The sidetone level is adjustable (from an access hole on the bottom of the Scout), but not the pitch. The access hole requires a fine jeweler's screwdriver and a very steady hand. If some SSB grabs you, you push the microphone button. The only adjustment is the settling of the microphone gain control. Adjust it so the LED flashes on voice peaks. There is no mode control.

I like to listen to CW with the filters wider than most people do. This is very easy to do with the Jones filter and the Scout. But, if you have the filter too wide and a strong signal is in the bandpass, the AGC will be controlled by the stronger signal. The fix is simple: Just tighten up the bandpass of the receiver. A simple turn of a knob is all it takes.

The internal keyer requires a 1/8" plug and the microphone requires a four-pin connector. Both are supplied by Ten-Tec. It's interesting to note that Ten-Tec has supplied all the Radio Shack part numbers for various plugs and adapters. That's a nice touch and it makes life easier for the new operator, too.

Impressions

The receiver in the Scout holds up quite well on the air. Granted, if you connect the Scout to a large super antenna and then compare it to something out of the same price range, you will be able to tell the difference. I used one of the pre-production Scouts during Field Day, and had no complaints about the receiver. Yes, it did get swamped from the other stations we had set up, but they all got hit just as bad.

> ***"You can't do anything wrong that will hurt the Scout. There are no memories to overwrite, no dual VFOs to worry about, and no complex multi-function knobs either."***

With 50 watts of RF, you're only 1/2 S-unit below that of a 100 watt rig. The difference between 50 watts and 100 watts is only 3 dB. An S-unit is defined as 6 dB. You'll have no trouble making and keeping a QSO with the power of the Scout. Under bad band conditions, sometimes 100 watts won't cut it, either. You can get the Scout in a QRP version for about $26 less, but I don't recommend it for a first-time ham. While God knows QRP is great fun, beginners in ham radio should have the benefit of 50 watts to get their feet wet. You can turn down the power of the Scout to QRP levels, but you'll end up losing transmitter efficiency.

Unsolicited comments from stations complimented the transmit audio on SSB. I used the hand-held Ten-Tec microphone for SSB. Microphone input is 200 to 100k ohms and it accepts microphones with 5 mV output. The microphone jack will also supply a low-voltage, low-current source for electrets.

I used the Scout on AMTOR with good results. It's more than stable to use just about any digital mode. I did not try RTTY. Since the heat sink gets very warm, almost hot on long-winded SSB QSOs, running full keydown would require some sort of extra cooling, like a small fan. Be advised, though, that the Scout's main purpose in life is CW and SSB. Running digital modes is quite possible with the Scout, but you'll need to keep the PA heat sink cool. Since the Scout selects the proper sideband for phone use, I had to adjust the software I used to invert the receive signal and the transmit as well. Most digital modes are done on lower sideband.

And, of course, what can you say about Ten-Tec's legendary QSK for CW? I operated with both the internal keyer and an external keyer. The sidetone is a pleasant 750 Hz, to match the offset during transmit.

The Scout is really at home in your car running HF mobile. A mobile mounting bracket is available. The noise blanker works very well with ignition-type noise pulses; I highly recommend this option for mobile use. Using less than perfect mobile antennas, I have been able to work states all over the country. Most don't believe me when I tell them I'm running only 50 watts mobile.

The Scout is also happy sitting on your operating table. While it's true that the Scout does not have all the bells and whistles of some of the other rigs in use today, it will still give you quite a lot of operating pleasure. The Scout is especially appealing to the new ham on a tight budget. One or two band modules (you get one with the Scout) would be all you need. The most popular modules are 40, 30, and 20 meters.

It's not a contest rig, and it was never designed to be one. However, I did use the Scout on the QRP ARCI CW contest with excellent results.

The Scout would be an ideal *second* rig also. You could throw it under your arm, grab the microphone with the other hand, and set up an emergency communication center in minutes.

What really took me by surprise while doing this review was a comment my wife made. With a basement full of radios and other electronic equipment, she said, "Why, I might even be able to operate this one. I don't think I could break it if I did something wrong." That's an interesting point. You can't do anything wrong that will hurt the Scout. There are no memories to overwrite, no dual VFOs to worry about, and no complex multi-function knobs either. I could just see Donna sitting down in front of an IC-781. All I'd be saying would be: "Don't touch this knob, don't touch that, and watch out for this, but don't worry about that one."

So, no matter where you are, be it camping, tooling down the road, at Field Day, or operating from home, the Scout will provide you with a lot of fun. In fact, I had such a good time with the Scout, Ten-Tec won't be getting this one back. I bought it!

Overall, I think Ten-Tec summed it up the best: "The Scout is easy, affordable and best of all, fun!" RF

Reprinted from 73 Amateur Radio Today, *March 1994.*

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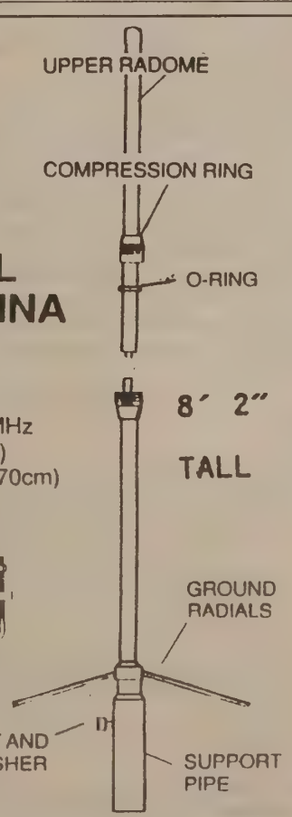

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The Ten-Tec OMNI-V

So quiet you won't know it's running.

by Bill Clarke WA4BLC

Ten-Tec recently introduced a new rig unlike any of the imports. In fact, there's no other rig like it on the market. This rig, the OMNI-V, is a super-performing, extremely quiet, "ham bands only" HF transceiver.

The OMNI-V HF transceiver features microprocessor control (through an RS-232 port via computer, if desired), PLL synthesizer with crystal mixed oscillator, and 25 memories. The memory channel will hold the frequency, mode, and filter selection. Optional filters are available to suit any need. It also has a voice frequency announcer option and an internal clock/calendar.

Packaging Counts

The OMNI-V arrived in two boxes, one for the transceiver and one for the optional Model 961 power supply. The boxes are built to prevent any chance of damage during shipping, short of total crushing. Each unit was individually wrapped in plastic for further protection. After unpacking the transceiver and the power supply, I placed them on my desk to determine their final positions.

The OMNI-V, compared to many of the imported transceivers I have used, is formidable in size. But, unlike most imported transceivers this size, it's not a desk-crusher because it has an external power supply (with a speaker on its front panel). Not only does an external supply save weight, it also saves on internal heat build-up caused by built-in power supplies. A large set of fins on the rear panel take care of cooling. There is no fan to make noise or need replacement, but an external fan is recommended when running continuous full power (RTTY, etc.).

Front Panel

The OMNI-V's large digital display, consisting of blue fluorescent characters half an inch high, stands out. The second notable feature is the fine receive audio (more on this later).

There are enough controls on the front panel to allow tailoring of operation to suit nearly any operator or circumstance. In fact, there are 56 controls on the front of the OMNI-V, and a few others on the rear panel: VOX, SIDETONE, MONITOR, and various inputs and outputs, such as AUDIO, RTTY, and XVTR. However, most controls are simple push-buttons.

Nothing is difficult or unusual about operating the OMNI-V. With the exception of the memory section, an experienced ham can "plug and play" the radio right away. After connecting the OMNI-V to the power supply and to my antenna system, I turned it on and tuned to my favorite portion of 75 meters.

Tuning In on the OMNI-V

The review unit had all optional filters installed, the voice frequency announcer, and the optional remote tun-ing knob. I sampled every feature of the OMNI-V except RTTY, for which I currently have no equipment.

Take a look at Photo A. You select the band and control the memory from the keyboard on the right side of the front panel. From a column of switches directly to the left of the main tuning knob, you select the mode. You control the VFO from the column of switches to the right of the tuning knob, and select the filter from the row of switches above the tuning dial.

Receive and transmit variable controls, AGC, attenuator, processor, and noise blanker are all located on the left side of the front panel.

After selecting the band and mode of operation, you can quickly tune up/down with the up/down buttons, at 10 kHz per push. FAST tune selects a 30 kHz step.

The main tuning dial is large, has a hefty smooth feel, and a finger-hole. The digital display shows the current frequency down to 10 Hz. The 10 Hz digit can be disconcerting to the uninitiated, as it only takes a slight movement of the tuning dial to move 10 or 20 Hz. Selection of FAST tuning increases the tuning speed of the dial.

Memory usage required a little study of the operating manual, but once I learned it was fast and easy. You can switch from VFO A to VFO B at the push of a button. Split operation is also available at the push of a button. The VFO in use is indicated on the display. Scrolling with the main tuning knob is a strong feature of the memory system.

The selectable filters system is great. Using the 2.4 kHz filter as standard for SSB reception gave excellent quality audio. When the going got tough, switching to 1.8 kHz dealt well with thick QRM. Using the 500 and 250 kHz filters really got me into the weak ones on CW. Selecting NARROW kicks in further filtering at the 9 MHz level and gives you steeper skirts on the passed signal.

For greater selectivity, you can add optional filters at the 9 MHz level to the existing 2.4 kHz filter. For example, you can install a second 2.4 kHz filter to give a total of 16 poles in this section.

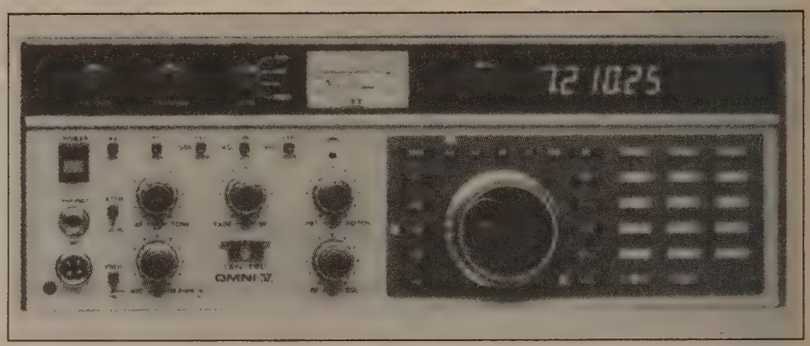

Photo A. The OMNI-V, showing the front panel layout. Notice the large digital display and large number of simple push-button controls.

"There are enough controls on the front panel to allow tailoring of operation to suit nearly any operator or circumstance."

The metering circuit displays FWD (forward), REF (reflected), Ic (final current draw), and PROC (processor) levels on a nicely backlit multi-scaled meter.

The BPF/FADE (bandpass filter) controls allow the user to tailor bandpass action to suit the situation. The amount of bandpass action is variable with a width of 35% of the selected center frequency at -6 dB points (from manual).

PBT (passband tuning) performed as expected, providing emphasized high or lows, and a good means of control over received audio. Receiver audio response can also be varied by the TONE control, although I found it to have only minimal effect.

There is no RIT (offset tuning) control. However, by using the alternate VFO (in split mode), you can effect a means of offset control. Although slightly different in operation from the RIT I am familiar with, it proved simple and effective.

AGC is less selectable from the front panel. Being able to turn off the AGC when the noise of man (QRM) is strong, allowing adequate reception by manual control of AF and RF gain.

The NOTCH filter is very effective with its 50 dB depth, but like all other current production ham transceivers, it's sensitive to operate. I much prefer my Datong Automatic Notch filter for removing carriers and heterodynes. I really would like to see the manufacturers pick up on automatic notch filters.

QSK . . .

Here is where Ten-Tec shines. If you have never operated CW with full break-in, you must sit down and try it with the OMNI-V. You can clearly hear between the characters you send. No more throwing the TRANS switch and leaving it on until you go K. A real class feature.

The side tone is completely adjustable on the rear panel for pitch and level.

The speech processor passed the acid test of local and DX operation. I found it unobjectionable on local 75 and 40 meter operation, yet very effective, and it really punched out for DX and weak 10 meter working. All in all, the unsolicited audio reports I received were good to excellent. No one said, "Turn the processor off!"

The RF output control operates separately from the MIKE gain control, and allows you to change your actual output power. This is perfect for controlling RF input to an amplifier.

On the rear panel is a MONITOR LEVEL pot that allows you to hear your own signal through the receiver's audio section. This is for setting speech processors and other audio controls for the transmitted voice signal. Headphones are required to prevent audio feedback.

The OMNI-V is current-limited at 20 amperes. This prevents the final transistors from being damaged when the antenna system is not matched.

The clock/calendar feature is nice, although I had little use for it, as I have a wall clock in my station.

An external PTT jack on the rear panel provides for foot (or other) switches.

The operating manual is very complete, with a theory of operation, operating instructions, and circuit diagrams.

Looking inside the Ten-Tec will be a sur-

prise to most modern transceiver users. There is space inside to work and move around. The boards are mounted apart, and plug-in wiring harnesses are used for interconnections. There is no crowding of components on the boards.

Receiver Audio Quality

Overall, the OMNI-V does extremely well with its receive audio. The internal speaker is more than adequate for most uses, and the optional power supply with its built-in speaker is even better. SSB signals seem to have a certain "audio presence" lacking in most of the other rigs on the market. This high quality audio was even more emphasized when I fed the OMNI-V's output to my station audio system.

I am a heavy user of 75 meters during the night hours, and as such I must live with the summer static levels. The OMNI-V hears through this junk better than any receiver I have ever operated. I tried duplicating this reception with my other rigs, using various speakers and filters. I was not successful. The OMNI-V does not hear static crashes well, and that's fine with me.

I asked other operators to listen to the receiver, then asked them what they liked about it. Each mentioned the "presence" of the received signals and the general lack of QRN.

To compare the OMNI-V to a typical PLL-based transceiver, I used my ICOM IC-751A. I found that on the ICOM, a typical 59 + 10 dB signal on 75 meters could be difficult, or at least uncomfortable to copy, when the static crashes were rolling in at 15 to 20 over S9. Switching to the OMNI-V and listening to the same 59 + 10 dB signal, the static crashes were reduced to below the 10 dB level and the copy was significantly improved.

This silent effect is quite similar to switching from a PLL-based transceiver to an older tube-type rig, such as a Collins or Drake, under the same noise conditions. Unfortunately, the latter rigs offer none of the niceties of solid-state microprocessor-based operation.

Praises—What I Like the Most

1. I cannot say enough about the quality of the receiver audio. It is absolutely excellent.
2. The large digital display is very easy on the eyes; you can read it from across the room.
3. The voice frequency announcer eases operation for the visually impaired.
4. Ten-Tec has provided a real relay for controlling linear amplifiers (including older ones).
5. Memory RAM and the microprocessor operating system do not require a backup battery (the clock/calendar does). This feature can be very important. For example, my ICOM 751A must have the microprocessor reprogrammed if the lithium backup battery fails.
6. The OMNI-V is a CW operator's dream.

Yawns—OK

1. The clock beeps at 16 minutes past the hour to remind the operator that WWV propagation information is being sent on 10 MHz. I personally found this to be annoying, but someone else may find it a valuable reminder.
2. The TONE control lacks authority.
3. The clock/calendar feature is not necessary.

Boos

1. An S-5 birdie breathes fire at 21.330 MHz (the factory is aware of this problem).
2. The VFO tuning knob needs a dial lock.
3. There are no provisions for AM operation (not a problem for most operators).
4. The plastic base of the desk mike is too lightweight.

Warranty Service

Normally, I wouldn't include warranty information about a new piece of equipment, but just read this quote from the Ten-Tec warranty page:

WE ENCOURAGE SELF HELP. Taking the covers off does not void the warranty. In many cases our customer service technicians, with your help, can identify a faulty circuit board or part. When appropriate, we will send you a replacement board which you can change. This will be shipped on a 30 day memo billing, and when the defective board is returned, we will issue a credit.

"The OMNI-V is a real performer with some of the finest receive audio I have ever heard on any ham equipment."

Having been in the service end of ham radio for a very long time, I can state emphatically that you will get no similar service from any other manufacturer of ham equipment.

The Secret of Silence

Ten-Tec has been extremely careful in designing the interaction of the crystal oscillator and LO mixer. Phase noise in the OMNI-V depends entirely upon the design of the 5.0-5.5 MHz synthesizer. In practice, the synthesizer is actually two loops operating at 200-220 MHz, tuning in 400 Hz steps, and divided by 40 to produce the necessary 5.0-5.5 MHz output. The division by a factor of 40 reduces the output frequency; but more importantly, it reduces the phase noise and spurious levels by a factor of 32 dB. That is, it's 32 dB quieter than a normal PLL-type circuit.

The synthesizer's output signal of 5.0-5.5 MHz is then mixed with the output from the crystal oscillator and filtered through a bandpass filter, amplified, and then filtered through a 9 MHz notch filter. Crystal and filter selection is microprocessor-based.

The receiver is inherently quiet due to the PLL-based VFO and use of crystal oscillator mixing circuits, versus the typical PLL-only circuitry found in most current HF receivers/transceivers. By employing crystal oscillators and mixing circuits for band selection, a large percentage of internally generated noise is eliminated.

Crystal mixing circuits are limited in bandwidth to the excursions allowed by the VFO. In this particular case, the standard VFO output of 5-5.5 MHz is derived from a PLL circuit and mixed with various crystal oscillators to arrive at specific bands. Each band is limited to a 500 kHz width. Band selection and switching of the desired oscillator and mixer circuits are done by microprocessor-controlled circuitry.

Because of this care in design, the OMNI-V is a real performer with some of the finest receive audio I have ever heard on any ham equipment. RF

Reprinted from 73 Amateur Radio, *April 1990.*

The Ten-Tec OMNI-V

General Specifications

Frequency Range	160-10 meters in 12 500 kHz segments 30 kHz overshoot on band ends
Control	Microprocessor-controlled digital PLL synthesizer with crystal mixer oscillator
Resolution	10 Hz
Display	7-digit fluorescent
Stability	1 PPM per degree C at 29.999 MHz (worst case)
Accuracy	+/- 100 Hz at 25 degrees C
Power requirements	RX 1.5A (13.8 VDC) TX20 A (13.8 VDC)
Construction	Aluminum chassis, extruded front panel G-10 Epoxy PCBs
Dimensions	5.75 x 14.75 x 17 inches (HWD)
Weight	16 lbs.

Transmitter

Modes	USB, LSB, CW, RTTY (FSK & AFSK), FM (optional)
DC Power Input	Max 200W at 14 VDC CW, SSB, FM 100% duty cycle for max 20 minutes (continuous w/auxilliary air cooling heatsink)
RF Power Output	25-100W adjustable w/front panel control
Microphone	Low-Z (5 mV at -62 dB)
T/R Switching	SSB VOX/PTT, CW Fast/Slow QSK
CW Sidetone	Adjustable tone/volume
SSB Generation	9 MHz 8-pole XTAL filter w/balanced modulator
Carrier Suppression	60 dB typical
Unwanted Sideband Suppression	60 dB typical at 1.5 kHz tone
Spurious Output	>45 dB below peak power output
TX Antenna Output	50 ohms unbalanced
Meter	Switchable forward power SWR Collector current Audio processing level
CW Offset	600 Hz
FSK Shift	170 Hz
SSB Monitor	Jack output

Receiver

Modes	USB, LSB, CW, FSK/AFSK, FM (optional)
Sensitivity	SSB/CW/RTTY 0.15 µV at 10 dB S/N @ 2.4kHz FM 0.30 microvolt at 12 dB SINAD @ 15 kHz
Selectivity	SSB Std 2.40 kHz at -6 dB, 3.36 kHz at -60 dB SSB Opt 1.80 kHz at -6 dB, 2.90 kHz at -60 dB CW Opt 0.50 kHz at -6 dB, 1.40 kHz at -60 dB CW Opt 0.25 kHz at -6 dB, 0.85 kHz at -60 dB FM Opt 15 kHz at -6 dB, 30 kHz at -60 dB
Attenuator	Approx. 20 dB
IF Frequencies	1st-9.0 MHz 2nd-6.3 MHz (FM 455 kHz)
RX Antenna input	50 ohms
Image Rejection	>60 dB
IF Rejection	>60 dB
Noise Blanker	On/Off adjustable width
S-Meter	50 µV at S9
Dynamic Range	97 dB typical
3rd Order ICP	+12 dBm
Squelch Sensitivity	<0.6 µV
Passband Tuning	+/- 1.2 kHz
Audio Output	1.5W at 8 ohms with <2% distortion
Notch Filter	250-2.2 kHz 50 dB notch typical
Audio Bandpass Filter	4-pole Variable center frequency 220-1.7 kHz 35% bandwidth at -6 dB Variable fader
Tone Control	Variable 15 dB rolloff at 5 kHz

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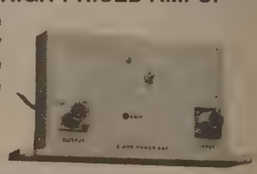

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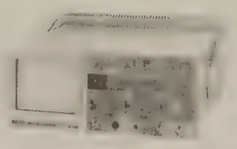

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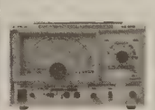

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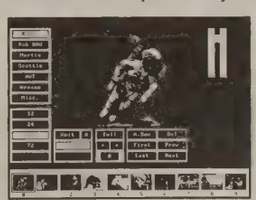

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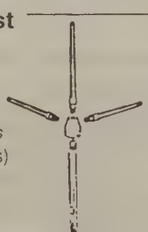

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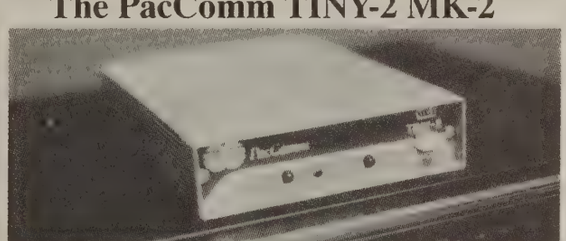

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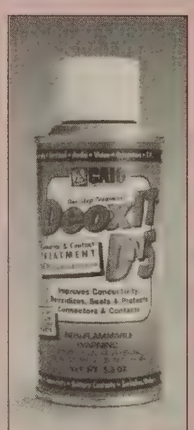

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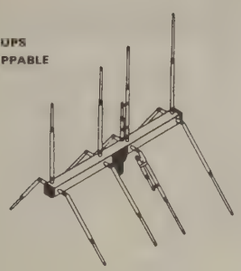

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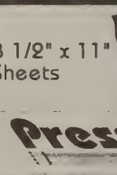

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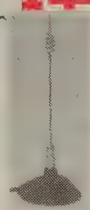

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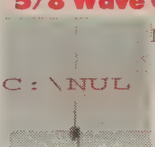

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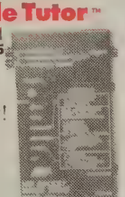

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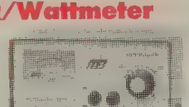

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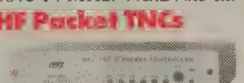

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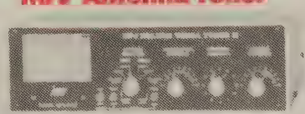

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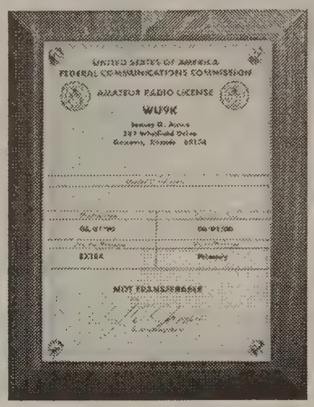

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FNB38,	9.6v	@	600mAh

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CIRCLE 105 ON READER SERVICE CARD

Don't Kill Your NiCd Batteries!

by Steve Katz WB2WIK

It seems like every time you pick up a ham magazine, there's a new circuit for a home-brew battery charger. But all chargers were not created equal. The best ones I've seen use pulse-width-modulated charging sources. Others use constant-current DC sources. They will all charge batteries, but it's important to know why some circuits do it far better than others.

The term "battery" refers to a network of electrochemical cells which are interconnected, usually internally, in series, parallel, or in series-parallel combinations. A single 1.2V nickel-cadmium device, then, really isn't a battery at all: It's a cell. A lead-acid automotive battery is a network of six series-connected 2 volt cells, and is truly a battery. Similarly, an aircraft battery is a network of 12 series-connected cells (24V total) that meets the definition of a battery as well. The problem with *any* battery is that it is only as good as its weakest link, or cell, within the network. If one cell in a series network fails, the integrity of the entire battery is at risk.

An electrochemical cell is a perfect source of pure direct current (DC). But it is best *charged* by a source of pulsating DC, which is AC with only one polarity. Your automobile alternator is such a charging source. It uses a three-phase, full-wave bridge rectifier without any ripple filtering and supplies that energy directly to your lead-acid battery when your engine is running. The ripple frequency of the alternator varies with engine speed, but the charging source is always pulsating DC and not pure DC. The thermal mass of an automotive lead-acid battery is huge by comparison with those used in miniaturized electronic equipment, so overheating and excessive outgassing from overcharging is rarely a problem. The ohmic resistance of the wiring between the alternator and the battery is enough to maintain a safe charging current, which in some cases could be more than 100 amperes.

A typical automotive lead-acid battery can deliver as much as 1,000 watts of DC power for a considerable time, and such a product might only cost $40 or $50. The demands placed on such a battery are very severe: Cold-weather "cranking" could demand several hundred amperes for 30 seconds or so, totaling 180,000 watt-seconds of energy! This might deplete most of the battery's charge, so after such abuse the automotive alternator will be called on to charge the battery at a very high rate for some time before the charge tapers off to more of a "float" level. During this high-demand charge cycle, the alternator ripple current will be very high; and because the battery is discharged, its internal impedance will be higher than normal as well. (A battery's impedance is inversely proportional to its charge state.) As a result, it is during this period that most amateurs using mobile "rigs" will find they have the severest "alternator whine" problem on transmit and/or receive. The battery is the *only* filter for the alternator, and it is not a very good filter when it's discharged.

Charging NiCds

So, what does all this have to do with charging NiCds for our little handie-talkies, and such? Quite a lot, actually. Although their chemical composition and internal construction differ widely, battery cells all have similar charging needs. Lead-acid cells, either "wet" or "gelled" (as in "gel-cells"), are the most robust and economical designs around, to date. They will take nearly complete discharge, and then recharge to nearly new capacity for thousands of charge cycles and ordinarily require replacement after three or more years of daily use. All this performance for $40 to $50! The operating cost of using an automotive battery for three years is about $0.04 per day—mere peanuts. If you pop for a more expensive automotive battery (some cost as much as $100 or so), you won't get much more performance than from the cheaper ones. "Marine" batteries are automotive batteries with a polypropylene rope handle attached to them, but as far as I can tell, there's no other difference. "Deep cycle" batteries are a bit different internally and are more suited for continuous discharging to near depletion; they are of no advantage in the average automotive application. "NiCds," on the other hand, are rather expensive for what they offer, which is maybe 324 watt-seconds of energy from a "pack" that costs as much as an automotive lead-acid battery!

Since NiCds are so dear, with average cost of ownership up in the $0.15-to-$0.20-per-day range, we may as well use them as best we can. The preferred charge method is to supply pulsating DC, not pure DC, to the battery terminals. The charge *rate* should be 1.2 to 1.5 times the battery's energy storage capacity, and both charging current and time figure into this formula.

For example, if you have a battery comprised of eight 1.2V NiCd cells rated at 450 mAH (milliampere-hours) each, you have a 259.2 watt-second battery pack (9.6V x 450 mA x 60 seconds). To fully recharge this battery, it will take 1.2 to 1.5 times more energy than this, which is 311 to 389 watt-seconds. (A watt-second is also called a joule, and we could use this term interchangeably to discuss energy ratings.) If the cells are "vented" so that internal pressure will not build during charging, they can probably handle "fast-charging," which is charging at a one-hour rate. To provide 389 joules to this battery in one hour, our charge current will need to be 675 mA. But many folks, including the cell manufacturers who presumably know what they're doing, discourage such high charge rates for cells with such small thermal mass. Let's be conservative and use one-half this current for twice the duration, which is still the same number of joules: This would be about 337 mA for two hours. This seems conservative enough to me, as only 404 mW (milliwatts) would be dissipated in each cell during charging, and 404 mW is not a great deal of power for such a large thermal mass.

If your cells are not "vented" and there is potential for pressure buildup during charging, you'll want to charge at a much smaller rate: The same number of joules will be required, but you'll need to use a longer duration. Let's say we pick 12 hours as a good charging time. If we need to put 389 joules into this battery over a period of 12 hours,

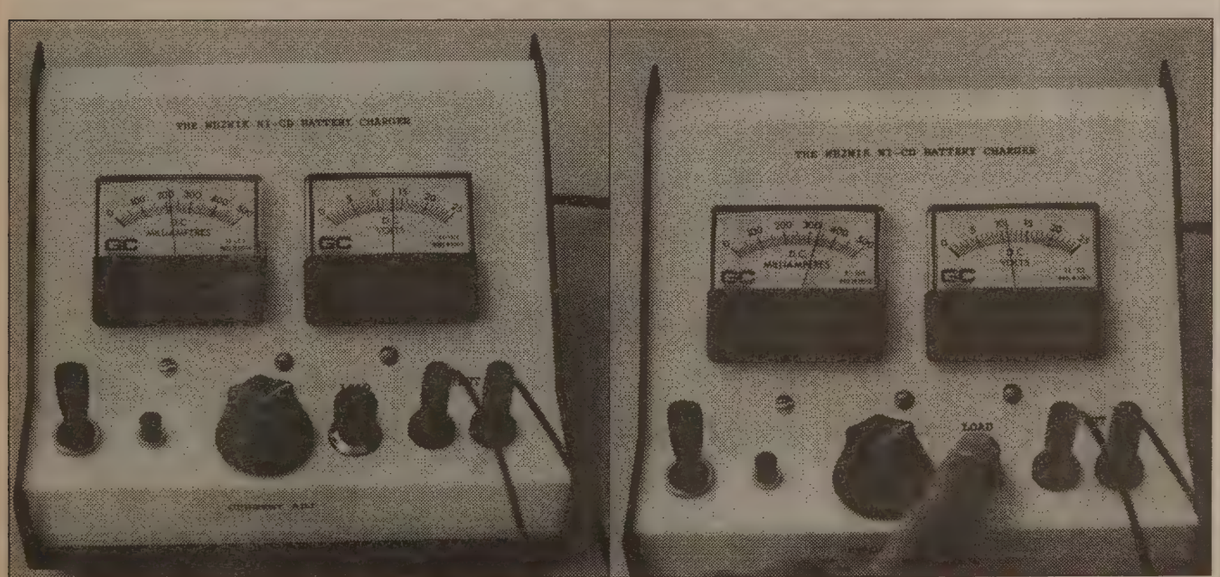

Photo A. (Left) The WB2WIK universal NiCd battery charger in action, connected to a 12V battery pack (out of the picture). The left-hand meter indicates charge current of 220 mA and the right-hand meter shows battery voltage of 12.5 volts, about right for a 12V pack that is being charged. (Right) Setup is the same as before, but this time I depressed the "TEST" switch button during the charge to see how well-charged the battery was. Current increased to 340 mA, and voltage dropped to 11V. This battery needs some more charging (see text).

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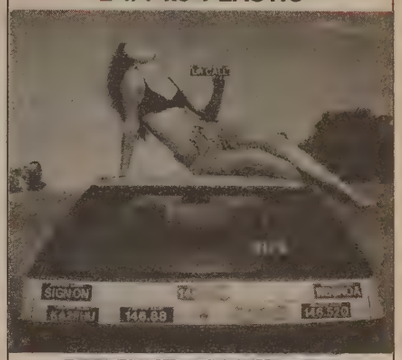

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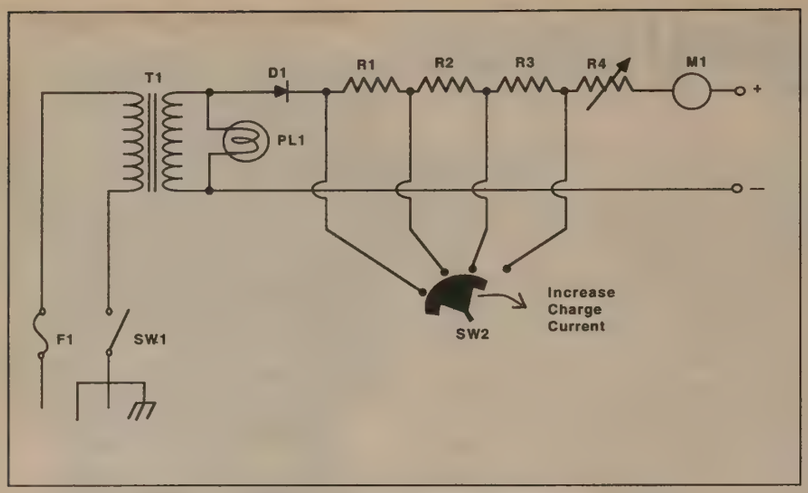

Figure 1. Pulse charger circuit.

this gives us a charge rate of 56.25 mA. The power dissipated in each cell during charging would be less than 7 milliwatts, a miniscule quantity.

I've read in a number of amateur-authored articles that the recommended charge time for standard NiCd batteries should be 14-18 hours. I have absolutely no idea where these numbers came from. I've contacted NiCd cell manufacturers around the world, and they don't seem to have any idea where these numbers came from, either. It seems to be a perpetuated myth with no foundation in any factual evidence. I use one-to-12-hour charge cycles for all my NiCds and they last me longer than anyone I know who uses commercially-manufactured chargers. Remember: Your 180 kJ (kilojoule) car battery can be fully recharged in a couple of hours, and lasts about three years (sometimes more) under these conditions.

It *is* true that NiCds will serve you longer if discharged prior to being recharged. Most of our modern amateur gear which is NiCd-powered will not allow destructive discharging because the equipment will "power down" or automatically shut off if the battery charge drops below a predetermined level. It is at this point that the batteries should be recharged. As such, if you don't have a "spare" battery pack, you'll be without the use of the equipment while you're recharging the single pack you have.

Evaluating and Exercising the Battery

To find out how good an old NiCd battery is, I use an old-fashioned method which works well. First, I use a voltmeter to measure the terminal voltage. If the voltage measures about 80%-90% of the "fully charged" rating (e.g., 7.7V to 8.6V for a 9.6V battery pack), I go ahead and charge the pack with the "fast charge" (one-hour duration) method *once,* and make another terminal measurement. If the battery charges to full potential (9.6V in our example), it is probably good and just needs a little "exercise" to bring it back to life. (I'll discuss the exercise in a moment.) If the battery does not charge back up to full potential, it probably has one or more bad cells in it. To exercise the battery, here's what I do (it works for me):

Apply a load to the battery which will discharge it fairly rapidly. You want to discharge it to about 80% of its fully charged potential, and do so within 10 minutes or so. If you have a pack of "AA" cells which are rated 450 mAh, you'll want to discharge them at about a 1 ampere *rate,* which, for a 9.6V battery pack, will require a 10 ohm, 10 watt resistor load, or a 12V, 6W incandescent light bulb load. Monitor the terminal voltage of the battery pack during the rapid discharge, and when the voltage drops to about 80% of the fully-charged potential, disconnect the load. The battery has now been exercised, and will feel a bit warm from the task. But this is not a destructive exercise (like a short-circuit would be), and good batteries will handle it just fine.

Now quick-charge the battery again, using the one-hour charge rate (or, for the faint-hearted, use the two-hour rate). It should charge up to about 5% above the rated terminal voltage (about 10V for our 9.6V battery). Now, exercise the battery once more with the fast-discharge load discussed above, and recharge again. If the battery survives these two discharge/recharge cycles and charges up to 5% higher potential than its rated "fully charged" voltage, it should be fine from this point forward and should serve you well. Future charges may be lower-current, 12-hour cycles if it makes you feel better (these don't make me feel any better at all).

I've used pulsating DC to charge an Icom BP3 battery pack for an ancient IC-2AT "handie-talkie" for more than 10 years, through a monitored 770 charge cycles (470 more cycles than Icom claims the pack is good for) and the pack still powers the "HT" as it did when it was new: About 12 hours of receive time, or 30 minutes of transmit time, or some combination of the two. This is what the battery was good for when it was new, and this is what it still does—not bad for a $30 battery pack purchased in 1984. My cost of ownership of that particular pack has been less than one cent per day, even lower than the daily cost of my car battery!

Some newer handhelds allow you to charge their batteries while operating. To prevent hum on the transmitted signal, this means a pure DC source is used in the charger. A nifty feature, but one that doesn't treat the batteries very well. This surely bolsters the manufacturer's battery sales business, but doesn't do much for our wallets except to keep them a bit thinner. I can think of better ways to lose weight.

A Better Way

The circuit for my universal NiCd battery charger appears in Figure 1. Note its incredible simplicity. No fancy regulator circuit, since I'm not charging with DC. Unfortunately, it is up to the builder to figure out a way to attach the charger to his or her battery pack. An easy way is to use the original manufacturer's "charger stand" (desk charger) and bypass the electronics contained therein, replacing the guts with the charger circuit shown here. This is exactly what I've done with my Icom and Kenwood "charger stands" and my circuit, while simpler than the original, seems to make the batteries last longer. And isn't that what using rechargeable batteries is all about?

How to Use the WB2WIK Pulse Charger

Using this charger is as easy as slicing bread and a lot less dangerous. Plug the charger into an AC outlet and throw SW1 (the power ON/OFF switch) to the "ON" position. The pilot lamp PL1 should glow, indicating the charger is powered up. With the charge current switch SW2 all the way counter-clockwise (placing R1 through R4 all in series with the battery), connect the battery to be charged to the + and - charging terminals. (It should be obvious, but, yes, the + terminal goes to the positive terminal on the battery and the minus terminal goes to the negative.)

It doesn't matter what the battery voltage rating is, as anything from 1.2 to 13.2V is

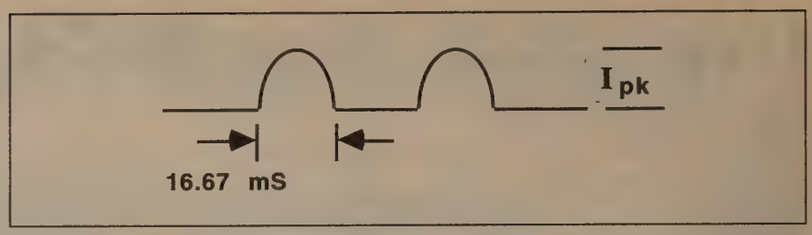

Figure 2. Current waveform.

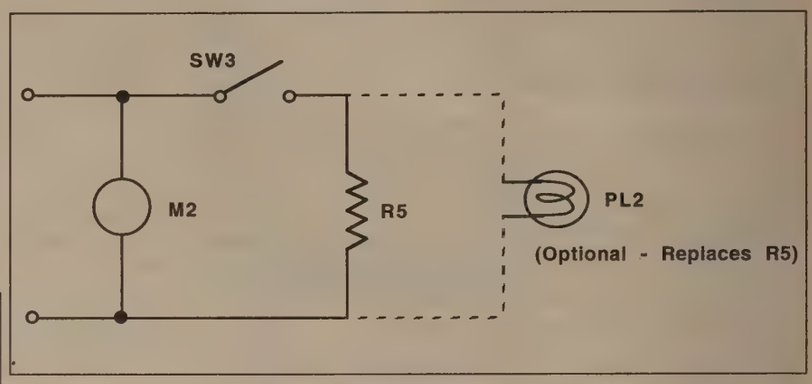

Figure 3. Discharging circuit.

Battery Voltage	Charging Current 10 mA	100 mA	200 mA	400 mA	800 mA
6.0V	1k	100	50	25	12.5
7.2V	680	68	34	17	8.5
8.4V	560	56	28	14	7
9.6V	440	44	22	11	5.5
10.8V	320	32	16	8	4
12V	200	20	10	5	N/A
13.2	80	8	4	N/A	N/A

Table 1. Approximate series resistance values (R1-R4 combined) for various NiCd battery voltages at charge currents.

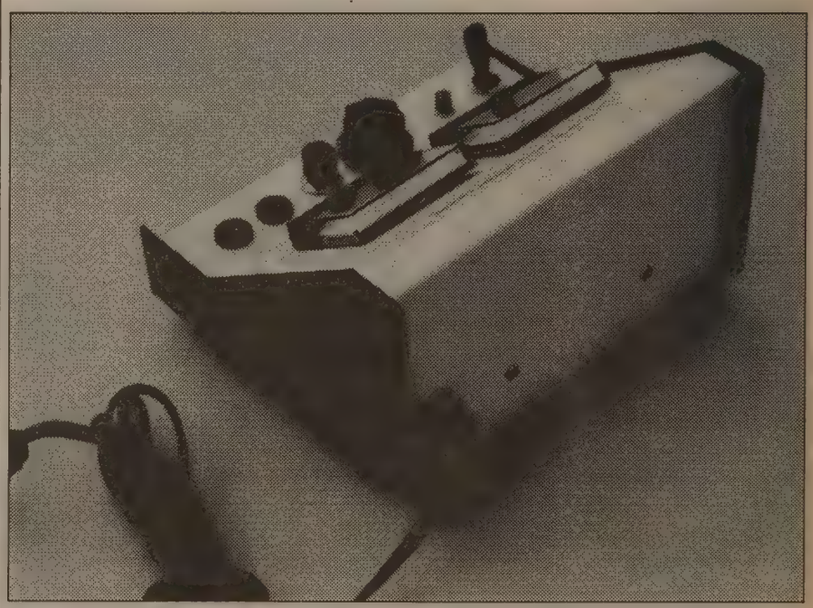

Photo B. Rear view of the WB2WIK universal NiCd battery charger, showing the fuse holder and the AC line cord exit. The two screw heads on the rear panel bolt down the 12 volt transformer inside the unit.

fine. In Table I listed some approximate resistance values that would be appropriate for battery packs ranging from 6.0 to 13.2V. Higher-voltage battery packs (extremely rare for ham radio apparatus) cannot be charged with this circuit, as sufficient potential is not available without changing T1 to a higher-voltage secondary transformer.

Observe the meter reading on M1 and turn switch SW2 clockwise until the approximate charging current is indicated. Then "trim" the current to the proper amount by adjusting rheostat R4 (increase resistance to lower current, reduce resistance to increase current). Using the combination of SW2 and R4 to adjust the charging current, almost any current you want can be obtained.

The rule of thumb for "fast charging" NiCds is to use about 1.33 times the ampere-hour rating of the battery for a period of one hour. For a battery pack assembled of "AA"-sized cells (which are normally rated 450 mAH [milliampere-hours]), this charge current would be 600 mA. For "slow charging" batteries (safer if you don't know for sure that your battery pack uses vented cells rated for fast charging), use one-eighth (0.125 x) the ampere-hour rating for a period of 12 hours. For a pack of "AA" cells, this would be about 60 mA.

Since it is unwise and deleterious to the health of NiCds to overcharge them, it is an excellent idea to place an inexpensive appliance timer (available in hardware, hobby and electrical supply houses for about $10) on the AC line to the charger, and set it for the duration of the charge you desire. Most of these timers are adjustable from about half an hour to 24 hours, and simply turn off the appliance (normally a lamp, but in this case a battery charger) and are quite reliable. We could have designed an ON/OFF timer into this circuit, but with appliance timers being so inexpensive and readily available, it didn't seem worth it.

It is safe to place NiCds on "charge" permanently if a very slow "trickle" charge rate is used. This will not harm the batteries, and will keep them charged to maximum capacity for immediate use when needed. The "trickle" charge rate is usually about 1/100 of the ampere-hour rating. In the case of "AA" packs, this would be about 5 mA; to set the charger to such a "slow" rate, switch SW2 will need to be rotated all the way counter-clockwise to insert maximum resistance between rectifier diode D1 and the battery to be charged. If you intend to use the lower-current charge rates most of the time, you'll want to replace meter M1 with a more sensitive movement, e.g., 0-100 or maybe 0-50 mA DC instead of the 0-1A DC meter shown on the Parts List. However, if you do elect to use a more sensitive meter, remember never to turn SW2 so far clockwise that the meter "pegs," or you risk damaging the meter movement.

When not using the charger, or before connecting any battery to its charging terminals, crank R4 all the way "up" (maximum resistance) to assure that there are at least 100 ohms in the circuit. If switch SW2 is fully clockwise and rheostat R4 is set fully counterclockwise (minimum resistance) simultaneously, connection of a battery across the charger terminals could potentially damage both meter M1 and the battery pack itself. In the event of a total short circuit and no series charging resistance selected, fuse F1 will blow open and disconnect the whole works. If you intend to use only slow-rate (low current) charging, you can replace diode D1 with a common 1N4001 instead of using the more robust 1N5550 called for in the parts list.

Happy charging! RF

Parts List

Part No.	Description	Suggested Supplier	Suggested Retail Price
D1	1N5550 or 1N5401	General Instruments	$.39
F1	3AG-1/4A	Bussman Mfr.	Box/5: $1.95
M1	DC ammeter	GC #20-1116	$17.70
M2	DC voltmeter	GC #20-1123	$17.70
PL1	12V pilot lamp assembly	IDI #B2194A1	$4.48
PL2	12V 6W automotive lamp	(not used in my project)	
R1	390 ohm, 2W resistor	Philips-ECG #T139	$.59
R2	200 ohm, 2W resistor	Philips-ECG #T120	$.59
R3	100 ohm, 2W resistor	Philips-ECG #T110	$.59
R4	100 ohm, 10W rheostat	Ohmite #RES100	$15.48
R5	25 ohm, 10W resistor	IRC #PW10	$.69
SW1	SPST toggle switch	Arcoelectric #C1800G	$3.23
SW2	1-pole, 4-position rotary switch	GC #35-379	2.99
SW3	SPST momentary contact push-button	GC #35-411	$2.19
T1	12.6V filament transformer (1A)	Caltronics #T1261	$8.40

Additional parts not on schematic diagram:

Banana jack output terminals	ITT-Pomona #4921-0 (black & 4921-2 (red), one each	$2.40 each
Slope-panel cabinet for assembly of charger	LMB #007-746	$23.54

(Fancy cabinet not required: Could be assembled on a piece of plywood if you wish!)

Total cost for all parts, including the fancy sloped-panel cabinet shown, is $107.14 retail. Discounts may be available. Shop at surplus houses and swap meets for bargains! This project can be built for under $25 with judicious shopping, but even at $107 it is very competitive with "commercial" chargers that have no metering and no adjustable charge rates!

Author's Notes

In discussing the contents of this article with fellow hams and engineers prior to its publication, I found myself asking the same question as my friends: "Why does pulsating DC seem to work better when charging batteries than pure, filtered DC?" I'm unsure of the answer and couldn't find anyone who knew for certain, although many seemed to agree that, based on their own experiences, pulsating DC does work better and allows more charge cycles.

In building this project, don't worry about parts layout or precision wiring. There's nothing to the circuit and all wiring is either 60 Hz AC or DC, so wiring is not critical. Although I used the fancy sloped-panel cabinet shown in the photograph, this item was by far the most costly component in the project and it isn't necessary to use such professional packaging. If you like the professional look and don't want to spend nearly $30 on the cabinet, one can be home-brewed from aluminum sheet stock bent appropriately, or even fabricated from 1/4" plywood which is tacked and glued together, then painted to impart a "finished" appearance. This might only cost $5 instead of $30 and the overall project will work exactly as well.

Also, feel free to experiment with the values of series resistance used between the rectifier diode and the ammeter. If you intend to use "rapid-charge" batteries exclusively, you don't need to include the 100 ohm, 220 ohm or 390 ohm resistors at all and can replace them with much lower values like 5 ohms, 10 ohms, and 20 ohms, which will yield higher but still selectable charging currents. If you intend to mostly "trickle-charge" (or slow-charge) your batteries, you might want to use only the higher resistance values and omit the 100 ohm rheostat (a rather costly item when purchased retail) entirely. It's all up to you. If you wish to charge exclusively at lower-current rates, use a lower-current milliammeter instead of the 1 ampere meter shown.

In my case, I decided to use a 500 mA full-scale meter, which allows me to charge at rates up to 500 mA or so and still allows some resolution down at the lower-current charge rates like 20-50 mA. Also, I used a 25 VDC full-scale voltmeter in my project because I do have some higher-voltage nickel-cadmium battery packs used for high-intensity photographic strobes (flash tubes) and a portable videotape camera/recorder and wanted to be able to read their voltages as well as the lower-voltage handie-talkie packs. As shown in the photograph, I used a normally-open, single-pole push-button switch for S3, which places a load resistor directly across the battery only momentarily, while the switch is being pushed. Depressing the switch button allows me to perform either of two functions: (1) discharge a partially-depleted battery pack, so that it may be more effectively charged back up by the charging circuit, and (2) placing a load on a charged battery pack to see how well it took the charge.

If you have a "fully-charged" battery pack whose merit you'd like to test, connect it to the charging terminals with the charger turned *off*. Read the battery voltage on the voltmeter, then depress the load switch S3 and note the battery voltage again. A fully-charged pack should not change voltage at all when S3 is depressed; a partially-charged battery will probably drop in voltage by about 10% when the button is pressed; and a battery that is nearly discharged or "dead" will drop in voltage much more than 10%. It only takes a second or two to perform this test and yields valuable information about the status of your battery.

I used "banana jacks" as the output terminals for my charger, and used multipurpose "E-Z hook " test leads to connect to various battery packs. However, some modern battery packs have no terminals to which the "E-Z hook" clips may be attached. For such packs, and my Kenwood PB-13 battery pack is one example, I build special charging fixtures which allow the battery to be placed with its DC terminals against common household nail heads, and held against those nail heads by the pack's own weight. The test lead hooks are clamped farther down the nail bodies for electrical connections. Sounds crude, but works great and costs maybe 50 cents each to make these special fixtures.

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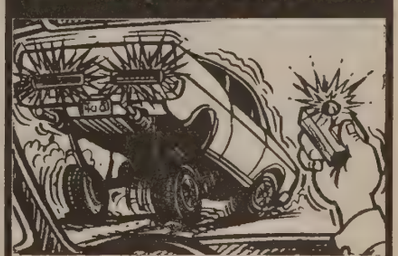

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the tech side

by Michael Jay Geier KB1UM

More "What Is That Thing?"

Last time, we were discussing the various kinds of components, what they look like, and how to identify them. There's lots to cover, so let's continue.

R (resistors): There are resistors with values less than 10 ohms, but 10 ohms is the lowest value which can be represented with the standard color code. The code for a 10-ohm resistor would be brown, black, black (1,0, and zero zeros). So how do you code, say, a 5-ohm resistor? The only way is to add a few special colors to the multiplier band. If you see a resistor with the multiplier band (the one before the final gold or silver) *also* being gold or silver, you know the resistor is less than 10 ohms. If the band is gold, multiply the value shown by the other bands by 0.1. In other words, divide by 10. If the band is silver, multiply by 0.01, or divide by 100. So, a 5-ohm resistor would be green, black, gold, and then either gold or silver for the tolerance. You won't see such low-value resistors often, and you'll hardly ever see one with a silver multiplier, which would indicate a value of 1 ohm or less.

In addition to the normal, hot-dog-shaped resistors, there are some other kinds. Power resistors, which are basically like regular resistors, only bigger, can assume several forms. Some look just like their miniature cousins, but they may be anywhere from three or four to 50 times their size! Some power resistors, though, are rectangular white or yellow things with the value printed (not color-coded) on one side. Often, another side will have a sandy appearance. Now and then you may run into metal-encased resistors, some with heat-sinking fins. Whatever the style, you should always attempt to replace such a resistor with a matching type. In particular, some power resistors are of the "composition" type, which are made from ground powder. Others are "wirewound" types, which are really small coils of high-resistance wire. The wirewound parts can handle a lot of heat, and thus a lot of current, in a small package. But, like all coils, they have some inductance, which can cause problems in AC circuits, especially at radio frequencies. So, you want to be particularly careful never to replace a composition resistor with a wirewound part.

Included in the resistor category are potentiometers and trimpots. Potentiometers are the variable resistors commonly used for volume and squelch controls. A typical "pot" has a resistive coating which runs in an arc between the two outer leads. A wiper arm, connected to the center lead, makes point contact with the coating. As you turn the control, the wiper sweeps over the coating, changing the resistance between the center lead and the outer leads. The closer the contact point comes to one of the leads, the lower the resistance between the center lead and the one being approached. At the same time, the resistance from the center lead to the now-distant end goes up.

Like power resistors, pots can come in composition and wirewound varieties, and you shouldn't try to interchange them. The reason's the same: The wirewound ones have significant inductance.

Trimpots are just small potentiometers, and, although they can assume various forms, they work exactly the same way. Most trimpots are round, with a screwdriver adjustment in the middle. Usually, the available arc of rotation is about 250-300 degrees. Some trimpots, though, can be little rectangles which have a small adjusting screw, often on one end. These are multi-turn trimpots, which require the screw to be turned many times in order for the wiper to go all the way from one end to the other. That arrangement allows for very fine precision in the setting of the resistance value. If the manufacturer went to the trouble and expense of using a multi-turn trimpot, there must have been a good reason for it. So, don't replace one with a garden-variety trimpot; get another high-precision unit. They aren't very expensive. I've never seen a wirewound trimpot, although I suppose they may exist. Generally, though, the inductance issue doesn't exist with trimpots.

C (capacitors): There are more kinds of capacitors than I have room to discuss, but many types are fairly obscure; most of the time you'll see the same few varieties over and over again. Let's look at the major ones:

Those metal cans with the plastic covers and the + or - markings are electrolytic capacitors. The name comes from how they're constructed. In order to get lots of capacitance in a small package, an electrolyte chemical is used. The overwhelming characteristic of an electrolytic cap is its polarized nature. You *must* connect the voltage up with + to + and - to - or you'll destroy the cap. In fact, if you run across a broken rig which you know has been connected to its power supply backwards, be on the lookout for shorted electrolytics. Any connected directly across the incoming power are very likely to be ruined. When replacing electrolytic caps, be absolutely certain that the rated voltage of the new cap is as high or higher than the rating on the original one. Just as with reversed polarity, too much voltage will destroy an electrolytic.

A special form of the electrolytic is the tantalum capacitor. Tantalum caps are very small for their capacitance, even much smaller than regular electrolytics. Most tantalum parts have no real cases. Rather, they're dipped in an epoxy of some sort. So, they look like brightly colored, somewhat irregularly shaped droplets with wires coming out the bottom. Tantalums are very prone to shorting out, especially when reverse voltage or overvoltages are applied. I've even seen them blow themselves in half! So, keep an eye out for bad ones. Always replace a tantalum with another tantalum; they have important characteristics which ordinary electrolytics can't duplicate.

Larger, greenish, dipped capacitors with squarer shapes usually are plastic types. They may be mylar, polystyrene or some other material. They have much smaller capacitance values for their size than do tantalums or other electrolytics. Plastic caps are hard to kill. They're usually rated for 50 volts or more, and they have no polarity requirement. Generally, I assume these caps are good unless I see some clear sign of a bad one, such as physical distortion or measurements indicating a short. The exception is in some old equipment from the 1960s and early '70s, because some of the early caps of this type did have some problems. With modern gear, though, plastic caps are pretty reliable. You may come across some larger, box-shaped caps with square edges. Those are also plastic and should give little trouble.

Brown, coin-shaped capacitors are made from ceramic materials. Usually, their capacitance is 0.1 µF or less. They almost never go bad. I've only seen maybe two or three dead ones in my 30 years of electronicking. Generally, if it ain't physically broken, don't worry about it. If you do replace one, though, be extra careful about the temperature coefficient, which is the direction and amount of drift with change in temperature. In particular, if the cap says NPO on it, be sure to replace it with another NPO type. NPO stands for "negative-positive zero," and it means the cap won't drift in either direction as its temperature changes. You'll find NPO caps in frequency-sensitive applications such as VFOs, IF stages and other tuned circuits.

Like resistors, capacitors can be variable, too. The main use for a variable cap is to tune a circuit to a particular frequency. There are big variable caps and there are trimcaps. The big ones find use primarily as radio tuning controls. At least, they used to; many modern radios use digital frequency synthesis, so they don't need tuning caps.

The big variables can have air dielectrics (the material between the plates) or plastic dielectrics. Air units have the best temperature stability, so you should avoid using a plastic cap where an air cap was specified. Trimcaps are nearly always plastic or ceramic, although I have seen an air-dielectric trimcap once or twice. In any event, bad trimcaps are rare. When they do cause trouble, the usual reason is poor contact between the rotary half and its stationary connecting point. I've never had much luck fixing them; replacement is the best policy.

There are lots of other kinds of caps, but we've covered most of the ones you're likely to see. Next time, we'll get into other kinds of parts. Until then, take an old transistor radio, tape recorder or other expendable gadget, open it up, and try to identify as many parts as you can. The better you get at it, the more that previously incomprehensible pile of parts will start to make sense. 73 from KB1UM. RF

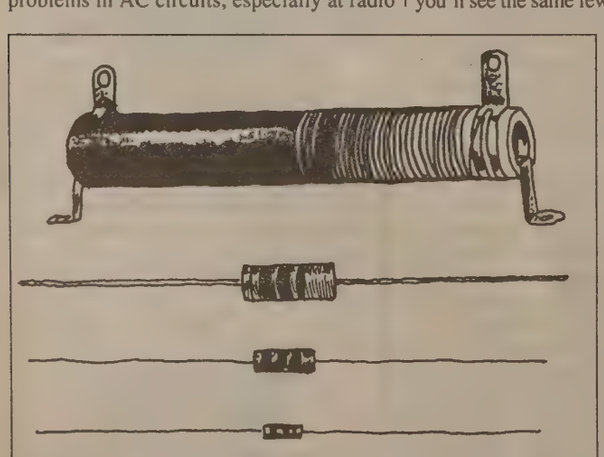

Figure 1. Power resistors may look like regular hot-dog-shaped carbon/composition types, or they may be wirewound like the one on top.

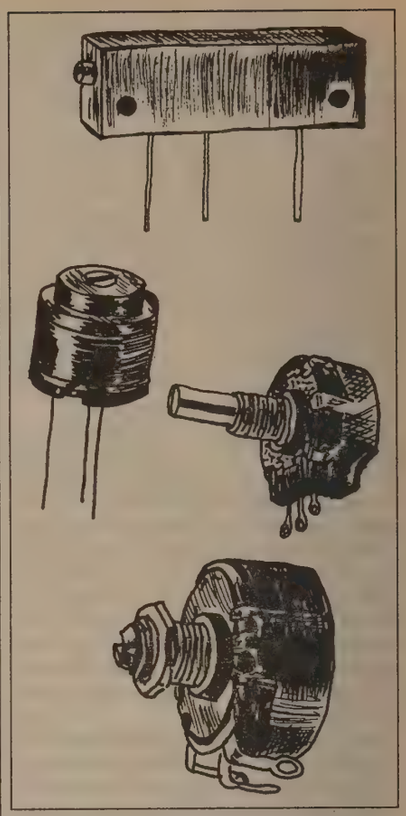

Figure 2. An assortment of potentiometers.

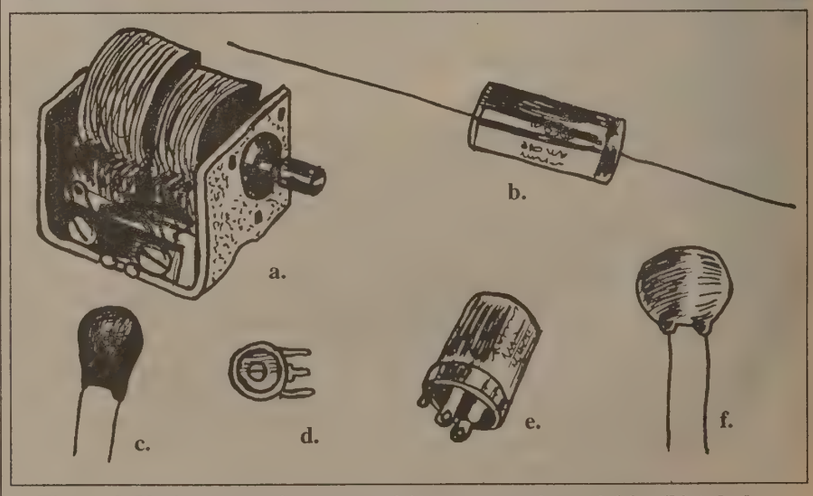

Figure 3. Various capacitor types: (a) two-gang air-variable; (b) tubular; (c) tantalum; (d) trimmer; (e) electrolytic; and (f) disk ceramic.

antennas, etc.

by Joseph J. Carr K4IPV

A Multiband Wire Delta Loop

Wire antennas are among my favorites because they are low-cost, reasonably well behaved, and can easily be erected and then torn down as the experimenting urge hits. Alternatively, if the urge to experiment is not something that hits you very often, or if you prudently lay down and let it pass when it does, then wire antennas are still (normally) easy to erect and are reasonably robust against the elements . . . so they last a long time with reasonable maintenance. As might be expected of a column that deals with antennas, etc., we take a look at quite a few wire antennas over the course of time.

This time, we are going to look at a multiband delta loop based on the G4ABS design published by the Radio Society of Great Britain (RSGB). Incidentally, if you are "into" wire antennas, RSGB publications have quite a few rather interesting designs. RSGB books are reasonably priced, even though imported. This month's antenna works on 3.5, 7, 14 and 28 MHz, and is constructed of #14 antenna wire and a 33-foot piece of either 300 ohm or 450 ohm twin-lead transmission line.

Figure 1 shows the multiband delta loop antenna. There are four sections to this antenna. Two sloping side sections are made of #14 antenna wire, and are 33-feet long. The top section is 32 feet of #14 antenna wire, but is cut in the center to form two 16-foot sections. Hanging from the center of the top section is a vertical section made of twin-lead transmission line (33 feet).

The two sloping side sections and the vertical section are brought to a connector board made of an insulating material such as ceramic, Plexiglas or even dry wood (if it can be kept dry and low power levels are used). We will take a look at the connection schemes for the different bands in a moment.

The antenna is supported in a manner similar to a dipole or any other wire antenna. The cut at the center of the top section and its connections to the vertical section are supported by an end insulator. The ends of the top half sections are supported by end insulators and ropes to nearby structures, just like a dipole. In some cases, a 33-foot or higher wooden mast might be used to support the center of the top section. In that case, the vertical section can be tied to it, improving its mechanical support. In addition, the connections board (used for band changing) can be mounted close to its base.

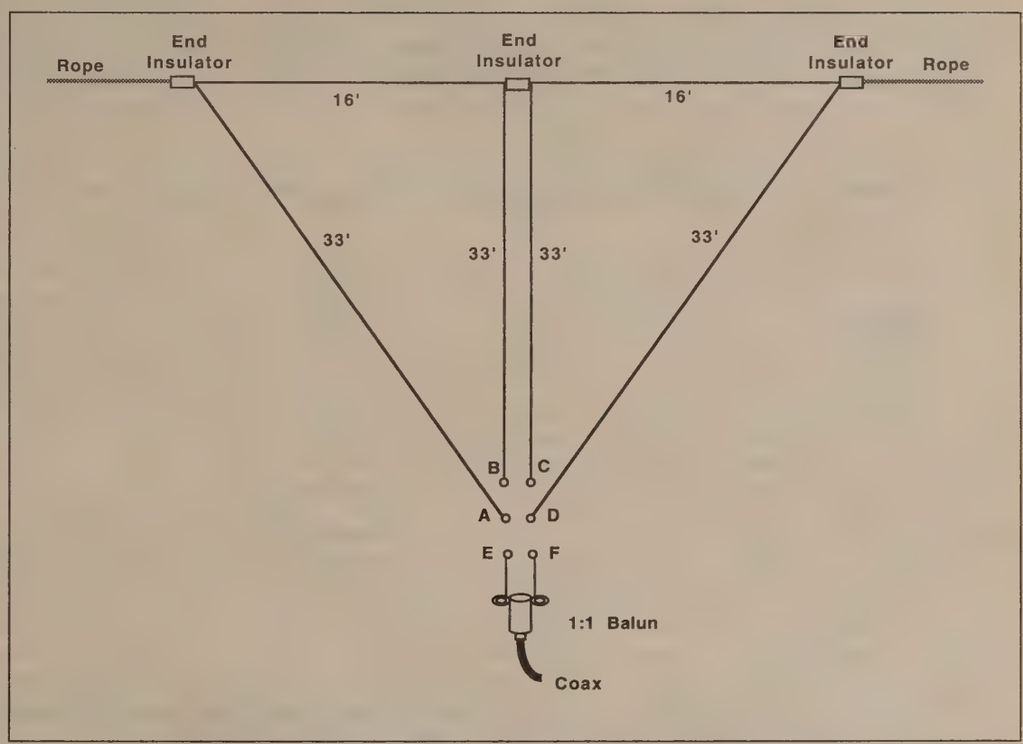

Figure 1. Multiband delta loop antenna for 3.5, 7, 14 and 28 MHz.

Figure 2 shows the connections scheme to make the antenna work on the four different bands (which, you will undoubtedly notice, are the harmonically related HF bands). All connections go to stand-off insulators, labeled A, B, C, D, E and F. The cheapest way to use these connection points is to manually connect a shorting wire between the appropriate terminals. People with a bit more $$$ to spend might want to get some coaxial relays, RF relays or vacuum relays in order to perform the switching. For very-low-power applications, the connectors can be five-way binding posts that accept a banana plug. The shorting could be done with short (very short!) pieces of wire tipped at each end with the banana plugs. The connections scheme:

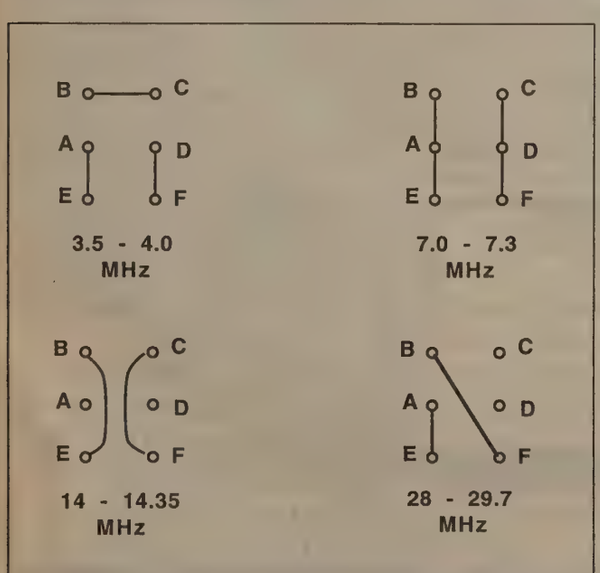

Figure 2. Connection schemes for band changing.

1. To make the antenna work on the 75/80 meter bands (3.5-4.0 MHz), short B-C, A-E and D-F.

2. To make the antenna work on 40 meters (7.0-7.3 MHz), short B-A-E and C-D-F.

3. To make the antenna work on 20 meters (14.0-14.35 MHz), short B-E and C-F.

4. To make the antenna work on 10 meters (28-29.7 MHz), short A-E and B-F.

My impression of the multiband delta loop is that it works about as well as a dipole, and is generally bidirectional. However, the pattern does seem to change considerably from band to band (which is to be expected). I don't want to say much about how it changes because propagation effects are so different on the four bands that it would take a very long time of observing signals to get a good idea of what the pattern looks like. Any statement about patterns, other than it appears to change from band to band, would be pure . . . uhhh . . . feldergarb.

Report from an Eclipse Observer

There was an annular solar eclipse on 10 May 1994 visible over a wide swath of North America. During an eclipse, the sun's energy no longer reaches the earth (for a brief period), so ionospheric ionization levels begin to deteriorate. The D-layer of the ionosphere tends to be most affected because air density there is high, so ions tend to recombine more rapidly once the solar energy source is dark. Gordon Hayward VE3EOS sent me a report of his observations. He monitored 5 MHz WWV because 5 MHz is a band seriously affected by the D-layer activity. He noted that the post-sunset signal levels of WWV rose 38 dB at his Ontario QTH, and then fell back down to baseline post-sunrise. During the eclipse he noted a 4-5 dB increase for the short period that the eclipse ground track was about midway between Fort Collins, CO, and his QTH (about 1700 UTC). A more complete report of this effort, plus information on hearing Jupiter's natural radio signals, can be found in my column in *73* magazine.

The eclipse experiment showed that amateur radio operators and shortwave listeners can do a lot of "amateur science" with their radio equipment. Most of these activities are propagation and natural radio signal observations. Many, perhaps most, can, like that of VE3EOS, be done solely with a radio receiver.

Some activities are:

1. Monitoring solar activity for sudden ionospheric disturbances in both the HF band and the very-low-frequency (VLF) band (20-40 kHz).

2. Making daily measurements of signal strengths of standard stations such as WWV, WWVH or WWVB.

3. Listening and recording signals from Jupiter (found in the 18-24 MHz region).

4. Monitoring radio sources outside the solar system on microwave bands.

5. Hunting for "whistlers" (i.e. electromagnetic radio waves in the 1 to 10 kHz region).

If you are interested in these activities, I have a bibliography of published sources on these signals, and information on how to monitor them. If you want a copy, send me a self-addressed *stamped* #10 business envelope, and I'll send you a copy of the bibliography. By the way, the envelope should have *two* 29-cent stamps on it. RF

radio magic

by Michael Bryce WB8VGE

For the last several months we've been looking at how our receivers work. Starting this month, we'll take a peek inside a transmitter or two.

At first, you might think a transmitter would be extremely complex when compared to a receiver. But guess what! The opposite is true! In fact, you'll find more hams building their own transmitters than building receivers. Small low-power transmitters for the QRP (low-power) operator are sometimes nothing more than a crystal oscillator coupled to an antenna!

A trip to your local Radio Shack store will yield all the parts necessary to build a low-power transmitter for the 80 meter CW band—including the crystal! Let's look at how we can take a spoonful of parts and create an honest-to-goodness ham transmitter.

If you think of a transmitter as a backwards receiver, you're on the right path. A transmitter takes a very weak (microvolts) signal and amplifies it up to several watts of RF in a QRP transmitter. Our receivers take this 2 watts or so of RF from the air (microvolts) and amplify it up to speaker level, about a watt or two.

Stage One

The first stage you'll encounter, in either a home-brew transmitter or the newest creation from Japan, is a crystal oscillator. Even in the microprocessor controller rigs today, the output going to the antenna is based on a crystal oscillator located somewhere inside the rig. In our example I'll avoid confusion by just starting out with a simple single-crystal oscillator.

If you recall the chat we had about oscillators, you'll have a much easier time understanding how they work. I won't go into their operation again here. All we really need to know is that the oscillator controls the transmitter's frequency. This oscillator may be a single crystal or a Hartley oscillator used in a VFO.

What type of oscillator is kinda up to the designer. Most of the QRP transmitters use some form of Pierce or Colpitis oscillator. They're easy to build and get going without too much hair-pulling. I'll show you a different scheme later on as we proceed through the stages.

In our example, let's say we use a simple Pierce oscillator and a crystal. Operation, by design, is simple. The oscillator runs at the crystal's frequency. But, there

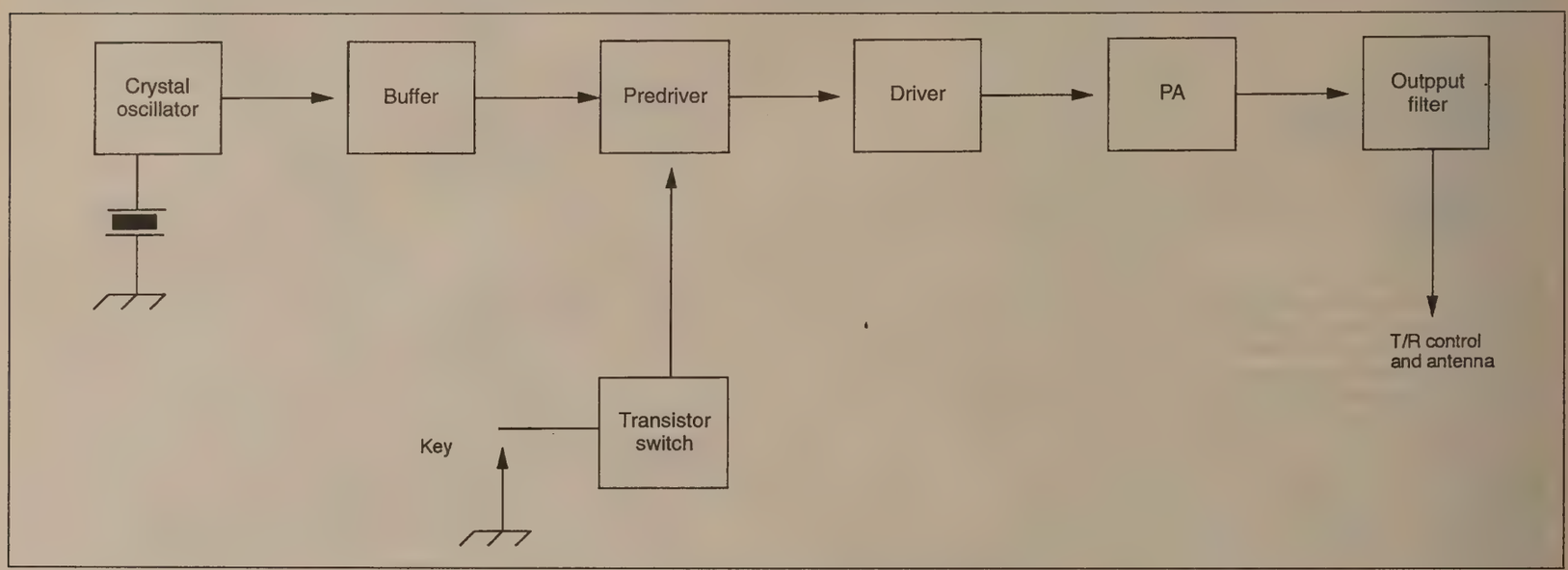

Figure 1. Block diagram of a simple CW transmitter.

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is very, very little power generated. We need to amplify this micro-power stage next. Of course, the best way to do this is with an amplifier. But wait! You don't want to do that just yet. If we add an amplifier right onto the output of our oscillator we can load the oscillator down, causing it to stop oscillating or to distort its waveform. A much better way to accomplish this task is with a buffer stage.

The Buffer

A buffer is really an amplifier, but with no gain. This is sometimes known as unity gain. The purpose is to add a stage to *buffer* the output from the input of the next stage, usually an amplifier. This buffer has no gain, as I said, but acts as an impedance matching network between the two stages. Since there is no gain, what you get in one end is the same level on the other end.

The idea is to pick off from the oscillator as little energy as you can. This will prevent the next stages from *pulling* the oscillator (when an oscillator is pulling during keydown the result is chirp).

Depending on the engineer, you can use several methods to tap off the oscillator. By far the simplest is to use a very small value capacitor to couple RF from the oscillator into the buffer. You can also use tuned circuits if you wish.

The Predriver

After the buffer, the next stage is an amplifier. Here the signal from the buffer will be increased, but not too much. You don't want to have too much gain in an amplifier. Remember, *oscillators don't and amplifiers do,* when it come to building a stable amplifier. Having too much gain in one stage makes that stage very hard to keep stable. You sure don't want your amplifier to begin acting like an oscillator!

In our example, this low-level amplifier makes a perfect place to insert a keying circuit. We could have just keyed the oscillator on and off at the source, but that introduces chirp, clicks and other critters on our signal. Here, by using a PNP transistor, we can control the keying of our transmitter by turning the voltage on and off, following our keying. This way, the oscillator runs all the time and is very stable, with no chirp, clicks, or buzzes. There is one drawback to this, however. You must turn off the transmitter's oscillator so you can hear the other station in your receiver. If not, all you'll hear is your own transmitter's oscillator!

Our keying transistor is very simple. The base of the transistor is connected to your key. This can be either an old straight key or your computer interface. When the base is pulled to ground, the transistor turns on. This allows the VCC to pass through to the collector of the amplifier's transistor. Since this transistor is now on, the amplifier boosts the output of the oscillator and sends the increased signal to the next stage: the driver.

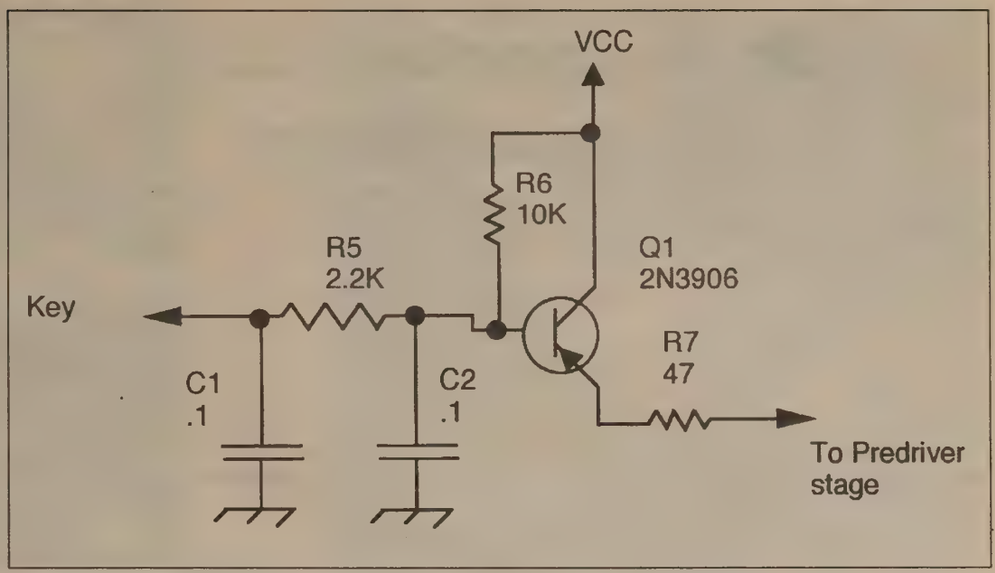

Figure 2. Schematic featuring a PNP keying transistor for switching the CW transmitter OFF and ON.

The Driver

The driver stage is very important to our transmitter. Here the still rather feeble signal is coupled from one stage to the other by a capacitor. Although you can use any other method of coupling RF from one stage to another, most QRP transmitters use this capacitor from the buffer to the driver. The driver stage usually has much more gain than the previous amplifier.

The driver stage also provides several other important functions. First, this stage is tuned to our operating frequency. By using a tuned circuit here we can get maximum output from our oscillator. We tune the driver to pass only the desired frequency, and no others.

Sometimes, depending on the designer, the driver is keyed instead of the proceeding stage. The keying works the same way in either case. The driver will demand more current, and therefore require a bit heavier keying transistor.

The driver also serves to match the impedance between the collector of the driver transistor and the base of the power amplifier (PA) transistor. This matching is necessary to allow maximum energy to reach the PA transistor. It also improves the efficiency of our transmitter. We don't want to lose valuable energy in the driver.

The block diagram (Figure 1) and schematic (Figure 2) show the flow of RF from one stage to another. There's not enough information here to build your own transmitter. We *will* be building a QRP transmitter, however. It will be able to operate on the 40 or 30 meter CW band. Our transmitter will produce about 2 watts, so it falls into the QRP category. Of course, we'll use a PC board and I'll try to put some kits together for those with shallow junk boxes. I don't know the final price yet as I'm still working out the details of the circuit.

But don't miss next month. I'll finish up the transmitter with the PA stage and the output filters. I also promise that you won't need your 59-function scientific calculator next month. In fact, leave your calculator in the drawer and start rooting through your junk box for pieces parts! RF

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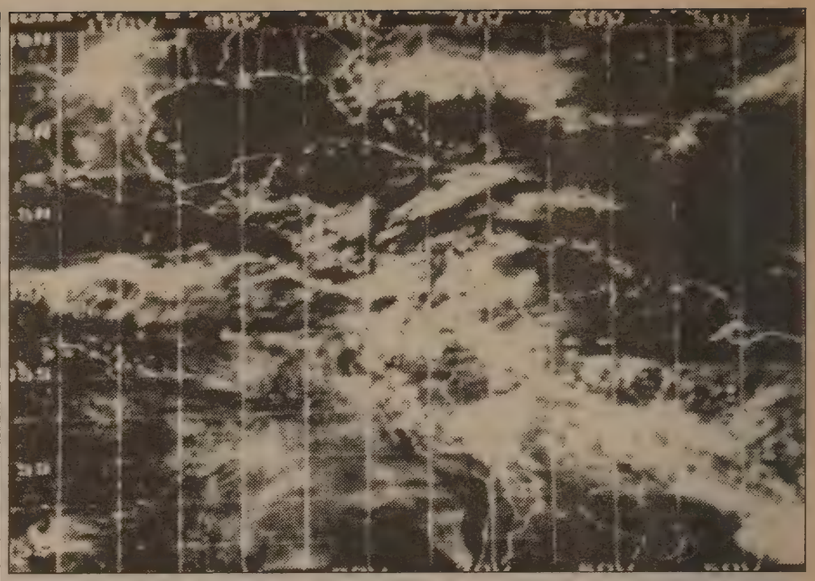

Photo B. Receive weather fax imagery on your laptop computer. This is the type of image your computer can display when hooked into the right receiver set and software.

Easy Weather Facsimile From Your Computer

If you own a laptop or home computer, there are inexpensive $100 weather facsimile programs which give you all the software and hardware necessary to pull in crystal-clear satellite photos and weather maps. You will need a high frequency shortwave receiver and a simple dipole antenna to pull in the weather pictures.

Government, military, and private shore stations send out weather facsimile broadcasts throughout the day and night on the following frequencies:

Navy broadcast, Cutler, Maine: 10,863.1 kHz daytime
3,355.1 kHz USB nighttime
8,078.1 kHz USB intermittent schedule
15,957.1 kHz USB intermittent schedule
20,013.1 kHz USB intermittent schedule

Since the Navy is pulling back on their scheduled weather FAX broadcasts, the National Weather Service will expand the Boston weather facsimile transmissions on the following frequencies:

3,240.6 kHz, USB, nights
7,528.1 kHz, USB, days

Along the West Coast, the National Weather Service has also expanded weather facsimile transmissions on the following frequencies:

4,344.1 kHz, USB, nights
8,680.1 kHz, USB, days
12,728.1 kHz, USB, days
17,149.3 kHz, USB, days
22,527.0 kHz, USB, days

For the Gulf of Mexico, weather facsimile broadcasts may be received on 6,850.1 kHz and 9,155.6 kHz during the day and evening hours from powerful public coast station WLO.

The United States Air Force weather facsimile broadcasts may be tuned in on 5,094.1 kHz, 6,902.1 kHz, 10,574.1 kHz, and 19,324.1 kHz both days and evenings.

To pull in these powerful weather facsimile broadcasts, all you need is a simple shortwave receiver or a ham set with general-coverage receive capability. Switch the ham set to upper sideband on all weather facsimile signals. On the little shortwave portable receiver, switch on the "BFO" beat frequency oscillator or, if it has selectable sidebands, choose USB. Most portable shortwave receivers in the $175 category and up offer SSB reception with VFO or selectable SSB filters. The very inexpensive shortwave receivers only pick up AM, and they cannot recover the audio from a weather facsimile transmitting station.

An external antenna is necessary with either the little shortwave set or a ham set. Shielded coaxial cable is absolutely essential to minimize the interference from your computer jumping over to the nearby shortwave set. A simple dipole separated at least 30 feet away from your reception area will do the trick nicely.

The sound you will hear of a weather facsimile transmission is a twice-a-second sweeping tone that varies in pitch to vary the 17 shades of gray getting painted digitally on your screen. The output of your shortwave receiver or ham set speaker jack is connected to an analog-to-digital COMM port plug which simply hooks up to the RS-232 serial input of your computer. The demodulator is powered by the computer, and the plug will not occupy any additional card slots. You don't even need to open up your computer to match the DB25 plug and cable assembly between the computer and your shortwave set. In the worst case, you will need an additional 9-to-25-pin adapter that may be necessary for laptop computers.

What You Need

Two companies offer $100 (approximate) weather facsimile programs including hardware and software:

Advanced Electronic Applications
2006 196th St. SW
Lynnwood WA 98036
(206) 774-5554; (800) 432-8873

Software Systems Consulting
615 S. El Camino Real
San Clemente CA 92672
(714) 498-5784; Fax (714) 498-0568

Each of these excellent weather facsimile systems uses a Windows type of presentation, and both require a minimum computer system setup:

IBM PC or compatible
MS DOS Version 2.1 or higher
640K RAM
Serial port
Video display CGA, EGA, VGA, or Super VGA

No printer required! Images are stored in 16 or 256 gray levels at a resolution of 640 X 800 or 1200 X 3200. Higher resolution modes will require an 80386 or 80486 processor and a minimum of 2 meg memory.

The weather facsimile imagery sent out on the shortwave frequencies is 80 percent weather charts and chart forecasts, and 20 percent satellite imagery only an hour or two old. Satellite imagery features geographic state boundary overlays, so you always know what you are looking at. In other words, all of the charts you receive have been specially formatted by the National Weather Service for easy at-home interpretation.

Best of all, you won't need to invest in expensive downconverters, tracking programs, or other high-tech peripherals to get started in weather facsimile reception. And if the weather facsimile bug really bites you, *then* you can get into more high-tech reception methods of down-linking the satellite imagery direct, superimposing your own state grids, and things like that. But for the beginner, these $100 programs and a little shortwave set with an outside antenna is all you need to turn your ham and computer station into a powerful weather facsimile forecast office! You can read the charts out on color or mono CRT, or watch them come across your LCD laptop screen. The broadcasts are out there, free of charge, so tune in with this simple software and hardware. RF

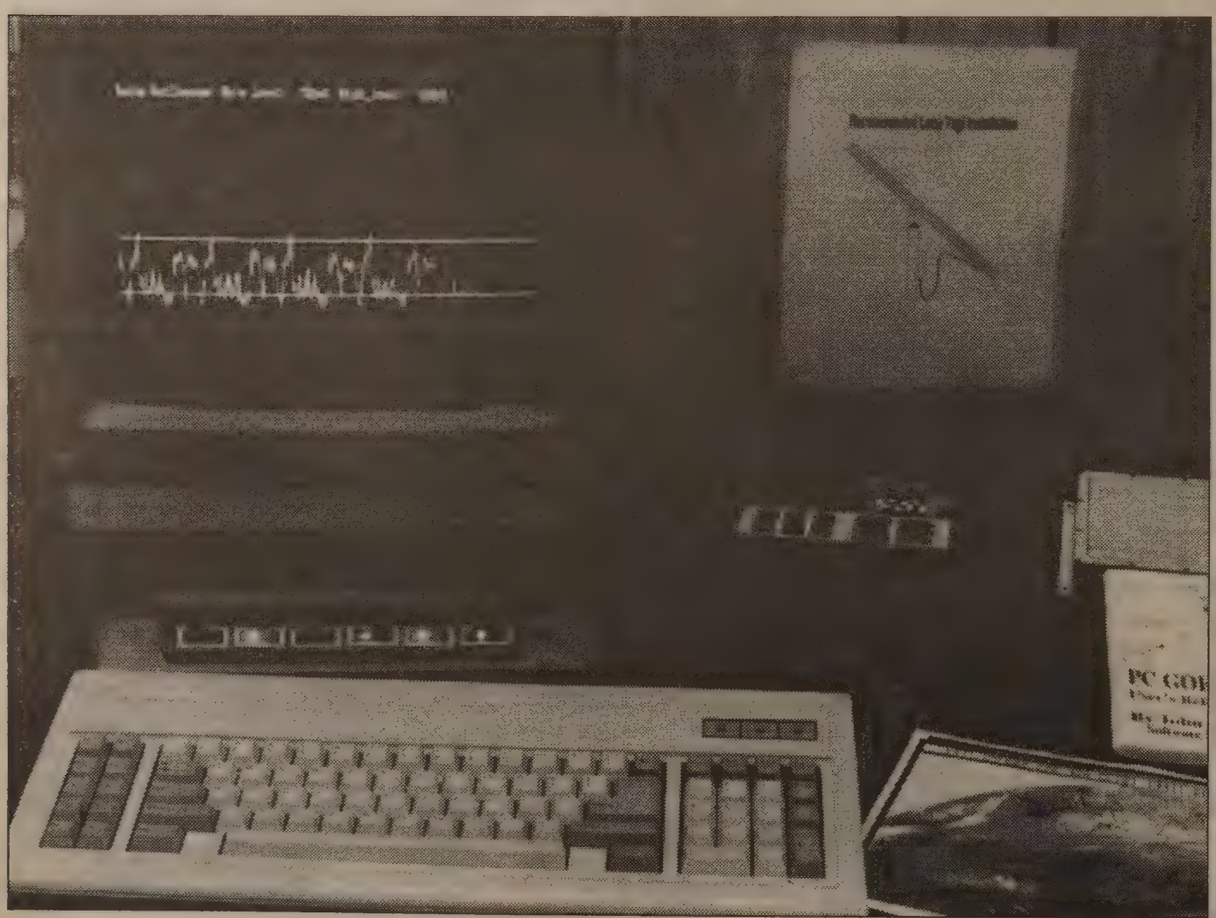

Photo A. A small worldwide ham set or shortwave receiver can turn your computer into a weather chart monitor.

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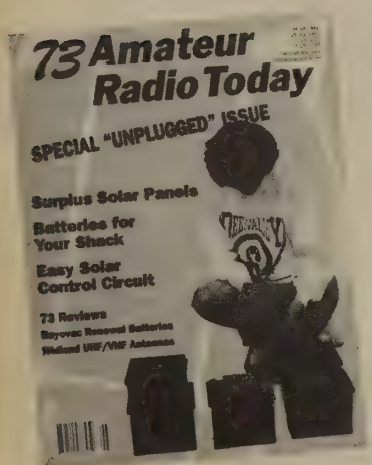

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what's next

by Carole Perry WB2MGP

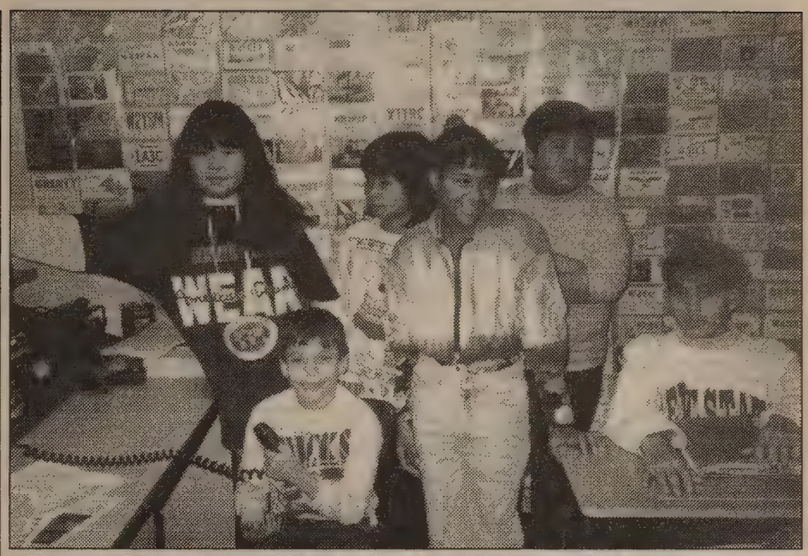

Photo A. Bring photos of kids having fun with ham radio in the classroom. Have them on display for the teachers to see.

Tips for Delivering a Successful Workshop

If you are an active instructor, classroom teacher, or recruiter for amateur radio, you already know the value of addressing large groups of people with "your message." Having taught "Introduction To Amateur Radio" to thousands of middle school children through the years on Staten Island, New York, I've gotten my fair share of publicity in the local media about the exciting work the students have been involved with via the radio. The local cable company as well as the local newspapers love to do stories about the kids being able to speak live with astronauts, the kids helping out in community events with their radios, and the proven positive influence of radio on the students' educational pursuits.

I was recently asked to give a workshop in our school district for other teachers who were looking to get new ideas to enrich their own curricula. I've done many of these kinds of presentations before, and I've developed my own checklist and guidelines to ensure a successful outcome. No matter what the group, there are certain basics that should be thought out ahead of time to optimize your effectiveness.

Know Your Audience

Firstly, you must always be aware of the general make-up of your audience; i.e., teachers, instructors, parents, teen-agers. Have a clear perception of what your goal for the workshop will be. Anticipate the needs of the people in attendance. Why are they there? What do they hope to gain from listening to you? Most importantly, your opening remarks should tell the group exactly what's in it for them.

There are 6 "P's" for you to keep in mind for making an effective presentation . . . Proper Preparation and Practice Prevent Poor Performance.

If your group is a relatively small one (under 25 people) like the teacher workshop I recently conducted, you might consider an introduction of each participant. I went around the room and got everyone's first name and had them explain exactly what age group and curriculum they were teaching. This technique makes the group feel more at ease, and gives you the clues you need for how to direct your remarks. Remember, they always want to know, "What's in it for me?" Your introductory remarks should now be geared specifically to the needs of the group and what you intend to show them.

Get Them Excited

To be effective, your opening remarks should develop rapport, gain everyone's attention, and establish focus. Nothing can ever beat the effectiveness of an enthusiastic speaker. To best prepare your audience for learning, you should generate excitement and interest in your very first statements.

I always come prepared with lots of handouts. There is a plethora of materials available for teachers who are using ham radio in the classroom. In advance, I have the appropriate number of interesting articles and informative bulletins run off for distribution. Teachers love to get reading material, and everybody likes to leave a seminar with something in their hands for future reference.

The body of your presentation should both provide and elicit information. Various skills should be demonstrated whenever possible, along with teaching concepts. Participants should be actively involved in your presentation. Be sure to allow time after each major concept is presented to have discussion and questions. I always try to remember to reinforce the theme of assistance and support. No teacher has to reinvent the wheel at this stage of the game. Any teacher who is considering bringing ham radio into the classroom to any degree can rely on help from national organizations, local radio clubs, other teachers who have proven track records with using radio in school, magazines, and national school nets.

The conclusion of your presentation should highlight the essential learnings, and summarize the central concepts and themes. Allow time for the group to "pull it all together." Encourage action planning with the members of your audience. Let them leave with the knowledge of what they must do next to implement their goals. Describe the appropriate follow-up support opportunities. Allow time for the group to give you feedback, either verbally or with evaluation forms. Lastly, promote a positive feeling of closure.

Provide Lesson Plans

The group I last spoke to consisted of middle school teachers from various disciplines. There were social studies, language arts, foreign language, special education, and science teachers in attendance. When doing my preparation work for the seminar, I composed lesson plans for sample enrichment lessons in each of their subject areas. They loved the idea of being given custom-made lesson plans.

I included the following items in each lesson plan: the name of the subject area, the objectives of the lessons, the materials needed for the lesson, the motivation, the lesson development and procedures, good key questions, and follow-up activities including evaluation ideas.

The more you tailor your workshop to the specific needs of your participants, the better your presentation will be. After you've done everything possible to make sure that your group has fun with your material, don't forget to have a great time yourself. RF

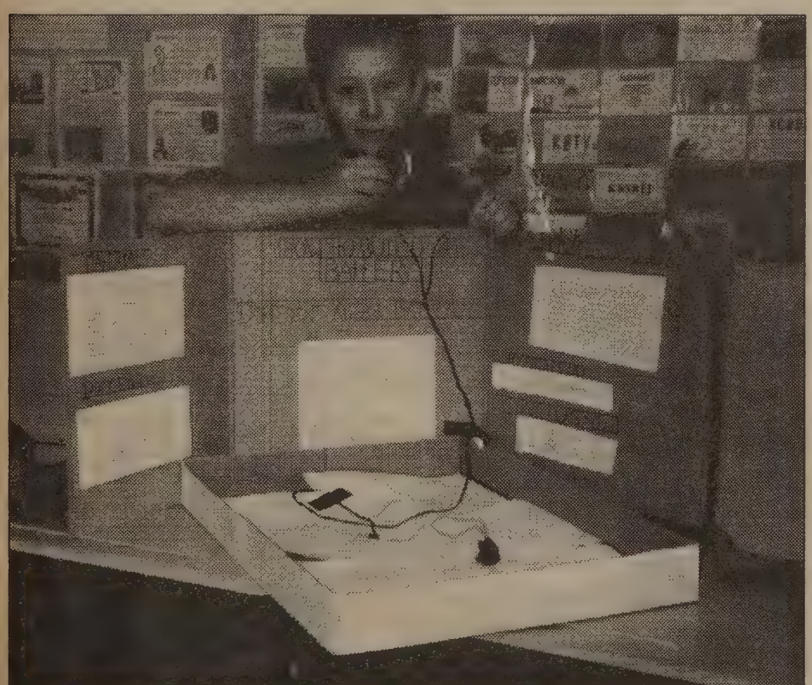

Photo B. Seventh-grader Sam Panensky demonstrates "how to build a battery" for extra credit in science.

Photo C. Seventh-graders Brian Carew and Robert Giarratano display a social studies project created after a radio contact.

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FREE HAM GOSPEL TRACTS, SASE. N3FTT, 5133 Gramercy, Clifton Heights PA 19018. RF960

activities calendar

Send your announcements to: Radio Fun Activities Calendar, 70 Route 202-N, Peterborough NH 03458. We'll print as many as space allows, on a "first come-first listed" basis.

SEP 2-3

NEW ORLEANS, LA The New Orleans Internat'l DX Convention will be held at Royal Sonesta Hotel on Bourbon St. Times: Fri., Sept. 2nd, 1 PM-11 PM: Sat., Sep. 3rd, 8 AM-Midnight. Registration deadline is Aug. 15th. For more info, call *(504) 283-4143 days only; FAX (504) 524-2129.* Send checks or money orders payable to: *New Orleans Internat'l DX Convention, c/o Michael Mayer W5ZPA, 5836 Marcia Ave., New Orleans LA 70124.*

SEP 4

ALAMOGORDO, NM The Alamogordo ARC, Inc. will sponsor VE Exams at 9 AM at the New Mexico State Univ. -Alamagordo, in the Pro-Tech Bldg. Electronics Lab. For further info, call *Ole WA5IPS, (505) 437-5896.*

SEP 10

ERIE, PA "Erie Hamfest '94," sponsored by the Radio Assn. of Erie, will be held 8 AM-2 PM at Franklin Twp. Fire Hall. Set-up at 5:30 AM. VE Exams at 9 AM at Franklin Center Methodist Church. Talk-in on 146.01/.61. Contact *Tom McClain N3HPR, 3954 Solar Dr., Erie PA 16506. Tel. (814) 833-1640.*

SEP 11

BOLINGBROOK, IL The Bolingbrook ARS will hold its 10th annual Hamfest/Computer Fair at the Inwood Rec. Center, 3000 W. Jefferson St. (Rt. 52), Joliet, IL. Time: 8 AM-3 PM. VE Exams 9 AM-noon. Talk-in on 147.33(+) kHz and 224.54(-) MHz. For details, call *(708) 759-7005.*

BUTLER, PA A Special Event will be held at the Butler Farm Show Grounds from 8 AM-4 PM. For details, contact *Joe Stallman WA3BVQ, 499 Kiester Rd., Slippery Rock PA 16057. Tel. (412) 794-8383.*

DUBUQUE, IA The Great River ARC, Iowa Antique RC and Historical Soc., and two computer users groups will co-sponsor a Hamfest/Radiofest/Computer Expo at the Tri-State Blind Soc., 3333 Asbury Rd. Time: 8 AM-3 PM. Talk-in on 147.84/.24. Contact *Loren Heber N0YHZ, 9479 Lauderville Rd., Dubuque IA 52003* or *Jerry Ehlers N0NLU, 3115 Brunswick St., Dubuque IA 52001. Tel. (319) 583-1016.*

MONETT, MO The Ozarks ARS Hamfest/Picnic will be held at Monett City Pk. Potluck Dinner at 12:30 PM. Talk-in on 146.97. Contact *Stan KF0KS, (417) 452-3801.*

SOUTH DARTMOUTH, MA The South Eastern Mass ARA will hold their 7th annual Hamfest/Flea Market from 8 AM-3 PM at the club grounds at 54 Donald St. Talk-in on 147.00/.60. Contact *Michael Enos, P.O. Box 79064, N. Dartmouth MA 02747.*

SUFFERN, NY The ARRL Hudson Div. Convention will be held at the Rockland Comm. College Field House, beginning at 9 AM. ARRL President George Wilson W4OYI, and staff members from ARRL Headquarters, will be among the featured guests. Flea Market. More. Talk-in on 147.165/.765. Vendors ONLY may call the convention's special Vendor Info Line at *(914) 426-1488.*

SEP 17

GONZALES, LA "Gonzales Hamfest '94" will be held at the Gonzales Rec. Center from 8 AM-3 PM. Sponsor: The Ascension ARC. Talk-in on 147.225(+), CTCSS 107.2. Contact *George Turner KB5EOC, 16179 Galves Ave., Prairieville LA 70769. Tel. (504) 622-3598.*

RANDOLPH, VT The Central Vermont ARC will host the "Fall Foliage Hamfest/Computer Fair" from 9 AM-3 PM at the Judd Gymnasium at Vermont Tech. College. VE Exams at 12:30 PM. Forums. Talk-in on 147.09/.69/R, 146.625/.025/R, and 146.52 simplex. For reservations, make checks payable to: Central Vermont ARC, and send to *Tom Girardi WA1YNU, P.O. Box 261, Waterbury VT 05676. Tel. (802) 244-7836;* or *Steve Allen KD1UP, RR1 Box 2409, Moretown VT 05660. Tel. (802) 496-7696.*

SCOTTSDALE, AZ The Family AR Event will hold its 2nd annual event at Rawhide Western Town, 23023 N. Scottsdale Rd. RC airplane demo. Weathersat forums. Emergency Ham Radio. Activities for children. Swap meet area opens at 6 AM. Exhibit hall opens at 9 AM. Contact *Len Winkler KB7LPW, P.O. Box 9219, Phoenix AZ 85068. Tel. (602) 861-0303.*

SEP 17-18

VIRGINIA BEACH, VA The ARRL Roanoke Div. Convention and Virginia Beach Hamfest will be held at the Virginia Beach Pavilion. Large computer exhibit. Major ham radio manufacturers. Ham radio dealers. For commercial booths, contact *Lewis Steingold W4BLO, 1008 Crabbers Cove Ln., Virginia Beach VA 23452. Tel. (804) HAM-FEST.* For tickets and tables, contact *Manny Steiner K4DOR, 3512 Olympia Ln., Virginia Beach VA 23452. Tel. (804) HAM-FEST.*

SEP 18

ADRIAN, MI The AARC Hamfest/Computer Show will be held at Lenawee County Fairground 8 AM-2 PM. VE Exams; walk-ins OK. Talk-in on 145.37(-). Get more details from *Greg KZ8X, 4281 Mohawk Trail, Adrian MI 49221. Tel. (517) 263-1153.*

CLEMENS, MI The 22nd annual L'Anse Creuse ARC Swap and Shop will be held from 8 AM-2 PM at L'Anse Creuse H.S. VE Exams at 11 AM. Contact *Don Olszewski WA8IZV, (810) 294-1567: Prodigy ID# SSTG41a.* Talk-in on the ECHO Rptr., 147.08/.68 MHz, or on 146.52 MHz simplex. For info, send SASE to *Dave Herrington N8NLK, 165 Crocker Blvd., Mt. Clemens MI 48043-2546. Tel. (810) 465-2797.*

LAUREL SPRINGS, NJ The 46th annual South Jersey RA, Inc. HAMfest will be held at Pennsauken H.S. starting at 8 AM. Reserve spaces by contacting *Diane Narfis N2LCQ, 17 Roosevelt Dr., Laurel Springs NJ 08021. Tel. (609) 227-6281.* VE Exams on a walk-in basis 9:30 AM until ???. Talk-in begins at 7 AM on the day of the event, on 145.290 (-600).

SEP 25

ST. PETERS, MO St. Peters ARC Swapfest will be held from 7 AM-1 PM at St. Charles County Comm. College Campus, 4601 Mid Rivers Mall Dr. Flea Market. Talk-in on 145.41 MHz and 444.275 MHz. Contact *Jay Underdown W0OGS, 58 Judy Dr., St. Charles MO 63301. Tel. (314) 723-4200.*

YONKERS, NY A Giant Electronic Flea Market, sponsored by the Metro 70cm. Network, will be held at Lincoln H.S. on Kneeland Ave. from 9 AM-3 PM. VE Exams. Talk-in on 440.425 MHz PL 156.7, 223.760 MHz PL 67.0, 146.910 Hz, 443.350 MHz PL 156.7. Contact *Otto Supliski WB2SLQ, (914) 969-1053.*

OCT 1-2

LOUISVILLE, KY The Greater Louisville Hamfest/ARRL KY State Conv. will be held at the Commonwealth Conv. Center in downtown Louisville. Mail requests for tickets or info to *The Greater Louisville Hamfest Assn., P.O. Box 34444-Q, Louisville KY 40232-4444.* For commercial spaces, call *(812) 948-0037; Flea Market spaces, (812) 282-4898.*

SPECIAL EVENT STATIONS

AUG 19-SEP 5

ISLINGTON, ONT., CANADA Amateur Radio clubs around Toronto Canada will operate Station VE3CNE 1400Z-0200Z each day as part of the Canadian Nat'l Exhibition in Toronto. Freq.: CW - 80 meters: 3.645/.700 MHz; 40 meters: 7.045/.145 MHz; 20 meters: 14.045; 15 meters: 21.045/.145 MHz. SSB - 80 meters: 3.745/.865 MHz; 40 meters: 7.065/.235 MHz.; 20 meters: 14.145/.245 MHz; and 21.345 on 15 meters. Talk-in on 145.410 MHz. Contact *(416) 393-6000* for more details.

SEP 1-5

MT. PLEASANT, IA Station W0MME will be operated by the Mt. Pleasant ARC during the Midwest Old Threshers Reunion. Voice and CW operation will be in the General portion of 80-10 meters. For a QSL, send an SASE to *Dave Schneider WD0ENR, RR3 Box 307A, Mt. Pleasant IA 52641.*

SEP 2-4

HAGERSTOWN, MD The Antietam Radio Assn. will operate Club Station W3CWC to commemorate the 125th Anniversary of the birth of Hiram P. Maxim W1AW, Founder of the ARRL. They will also celebrate the installation of a brass headmarker at his grave site in Rose Hill Cemetery. Operation will be from 1500Z Sep. 2nd-0400Z Sep. 3rd; also, 1200Z Sep. 3rd-2400Z Sep. 4th. Freq.: CW - 3.640, 7.045, 14.040, 21.040, 28.040. SSB - 3.920, 7.240, 14.240, 21.295, 28.350 MHz. For a commemorative certificate, send your QSL and an SASE to *Antietam Radio Assn., Attn: Special Event Station W3CWC, P.O. Box 52, Hagerstown MD 21741-0052.*

SEP 4

PANAMA, REP of PANAMA The 23rd Anniversary Contest of Radio Club Panama will take place 0001 GMT-2359 GMT. For details, contact *Radio Club Panama, Anniversary Contest, P.O. Box 10745, Panama 4, Republic of Panama. Fax: (507) 26-4477. Packet: HP1COO@HP1CDW.#PANCTY.PAN.CEAM.*

SEP 10-11

NORWALK, CT The Greater Norwalk ARC will operate KA1OFN 1300Z-2100Z Sep. 10th, and 1300Z-1900Z Sep. 11th, to celebrate the 17th Annual Norwalk Oyster Festival. Operation will be in the lower 25 kHz of the General phone band, on 40, 20 and 15 meters, and on the Novice 10 meter phone subband. For a certificate, send a QSL card and 9" x 12" SASE to the *Greater Norwalk ARC, 324-7 Main Ave., Box 115, Norwalk CT 06851.*

SEP 12-17

LINWOOD, NJ The Southern Counties ARA will operate K2BR from the Miss America Pageant in Atlantic City (Absecon IS., IOTA: NA 1J1). Freq.: Phone - 25 kHz inside lower General class bandedge; CW - 65 kHz inside lower General class bandedge; Novice - 28.100/.500 kHz. Operation will begin 10 AM EST on Sep. 12th. QSL - SASE via *SCARA, P.O. Box 121, Linwood NJ 08221.*

SEP 15-20

THE NETHERLANDS The Nijmegen RAC will operate Station PA6OMG to commemorate the Sep. 17, 1944 paratrooper effort to secure bridges in preparation for the advance of the British army over Dutch waterways (Operation Market Garden). PA6OMG will operate in CW and phone on all HF bands during the week. If possible, WWII radio equipment will be used to make connections. Send QSL cards to *QSL Manager, PA0KHS, NL-Region 35,* via the Dutch QSL-bureau. For local visitors, a 2m and 70cm talk-in will be on standby. A QSO with PA6OMG will be valid for the Noviomagum Certificate.

SEP 16-18

CHARLESTON, SC The Charleston ARS will operate WA4USN 1300Z-2300Z to commemorate the BOC Challenge 1994-95, a single-handed round-the-world yacht race. Freq.: 7.250, 14.045, 14.250, 21.045, 21.250. Novice CW portion of the 40 meter band, and 146.790. All frequencies +/-5 for QRM. 2 meter operation on Sep. 17th only. For a QSL, send QSL and SASE to *Sheila Frank KC4UDD, 614 Longstreet Circle, Summerville SC 29483.*

SEP 17

NEGAUNEE, MI The Hiawathia ARC will operate W3KGW 1300Z-2030Z to commemorate the 150th Anniversary of the locating of iron ore on the Marquette Range. Operation will be on the General band and on 146.91. Send QSL and SASE to *Charles Waters, 970 N. Westwood Dr., Ishpeming MI 49849.* Please put contact number on envelope.

PARK CITY, UT The Mercury ARA, in cooperation with the Great Salt Lake Council of the Boy Scouts of America, will operate K2BSA/7 during the Utah Heritage Jamboral. Operation will be from 0000Z-1800Z. Freq.: 3.870, 7228, 14287, 21395. Send QSL and SASE to *MARA, P.O. Box 11201, Salt Lake City UT 84147-0201.*

SEP 17-18

READING, PA Berks ARS will operate WA3MFT from 1600Z Sep. 17th-2000Z Sep. 18th, to commemorate the renovation to the landmark PAGODA. Phone frequencies: 3.880, 7.280, 14.280, 21.380, 28.480 and packet on 145.09. For a certificate, send your QSL and a 9" x 12" SASE to *Berks Amateur Radio Soc., P.O. Box 12632, Reading PA 19604.*

SEP 20-24

CHALK RIVER, ONT., CANADA The Renfrew County ARC will operate Station CJ31PM to commemorate the Internat'l Plowing Match coming to Renfrew county for the first time. The RCARC will operate on all bands, and a QSL card is available by sending an SASE to *RCARC, P.O. Box 39, Chalk River, Ont., Canada K0J 1K0.*

SEP 23-25

WALLA WALLA, WA The B.P.O. ELKS Lodge #287 is celebrating its 100th Anniversary. They will issue a certificate for working 5 Walla Walla stations. Please send names and calls on your QSL card to *Robbie Gallo KB7OBW, 351 E. Rose, Walla Walla WA 99362.*

SEP 24

SOUTH HOUSTON, TX The Pearland ARC will operate AB5GU as part of the city's Centennial celebration. Freq.: 28.410, 21.310, 14.260, 7.230, and 7.125. All school stations will be active during the preceding week. Jamieson Middle School will operate KI5MB; Pearland H.S. will operate KB5RGJ. Certificates will be sent to stations working all three locations. For QSL or a certificate, send an SASE via *Marty Haley AB5GU, 803 Ave. I, South Houston TX 77587.*

Speakers and Voice Communications

by Frank Kamp K5DKZ

Many hams prefer headphones to speakers. The use of headphones creates less noise at the operating position, which could interfere with others in the room. Headphones can also help significantly when conditions are marginal. Weak signals just seem to be easier to pick out from headphones than on a speaker. Unfortunately, the use of headphones is not always possible. Mobile operations generally require using a speaker, even though this is probably one of the best applications for headphones. Road noise, static and ignition noise all combine to make mobile communications less than armchair copy. Even under good conditions the speaker may not perform well if it is pointed at the floor or up into the dash. Good clean audio is almost universally recognized and appreciated. Getting it that way requires more than just a properly tuned receiver. Even the best receiver can sound marginal when attached to a poor speaker/enclosure combination.

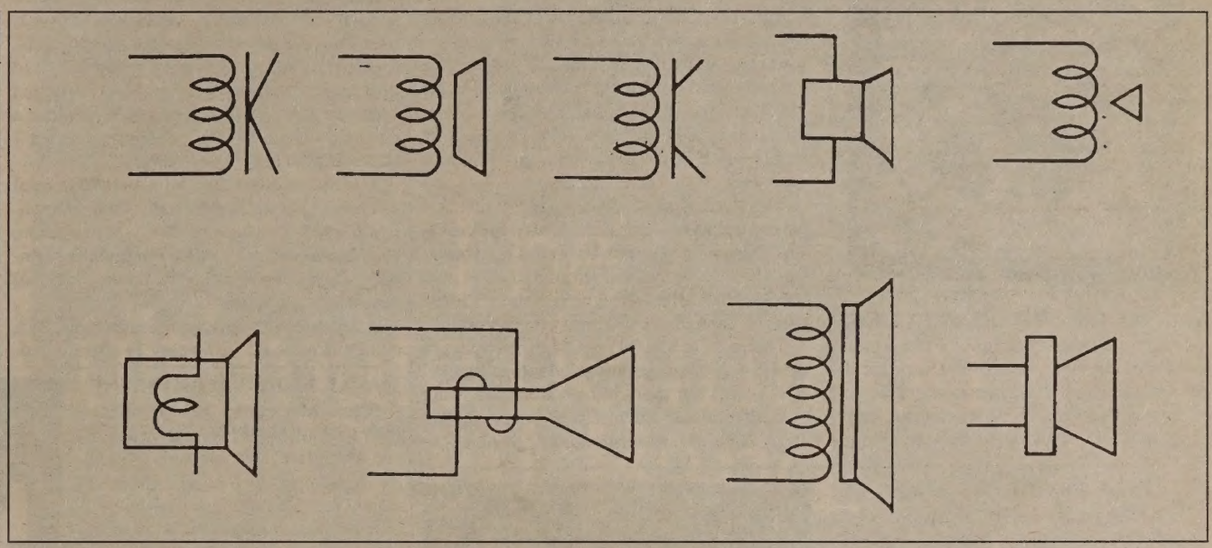

Figure 1. Speaker symbols.

A speaker/enclosure combination should have a linear audio frequency response and well-dampened transient response. Poor transient response will cause the speaker to "ring" on noise pulses and short, sharp speech sounds like P and K. This "ringing" tendency will cause the shock-excited speaker cone to vibrate unnecessarily, masking the next few syllables of speech. Linear response helps reduce audio cross-modulation products. This problem is similar to the intermod experienced with VHF repeater communications, but at an audio frequency. When two or more frequencies are fed to a speaker with nonlinearity problems it will generate harmonics of each of the two frequencies, as well as the sums and differences of each tone involved.

Both of these potential problems have a common solution which is a simple matter of picking the right speaker. Speakers with large magnets will have good linearity and transient response. This generally means selecting a speaker with 10 to 20 times the power handling capability of the audio available from the receiver. Inexpensive replacement speakers will cause problems and there is no real reason to go with expensive, wide-range, stereo component speakers. Our audio frequencies of interest range between about 300 and 3000 Hz. A speaker with good response to about 10 kHz will do very nicely in this application. A 5", 20 watt speaker will give good performance. I use a Realistic 40-1354A rated at 20 watts and 8 ohms. Before you make your selection look at the manufacturer's frequency response curve. The best candidate for communications use will have a reasonably flat response between 300 and 3000 Hz, rising smoothly at the higher frequency, then dropping off. Avoid any speaker whose response curve shows peaks within the 300 to 3000 HZ range.

"Even the best receiver can sound marginal when attached to a poor speaker/enclosure combination."

In mounting the speaker, we have two basic choices: The infinite baffle approach and the full enclosure. The baffle mounting is easier but takes up more space. For a 5" speaker the baffle should be made from a section of dense particle board 2.5' square. This will give you an approximate 6 dB rolloff in response below about 300 Hz. A smaller baffle will increase the rolloff frequency. A larger baffle will lower it. Avoid mounting the speaker in the exact center of the baffle. Center-mounting will ensure a significant dip in the response curve somewhere between 300 and 3000 Hz. Divide the baffle into four equal squares and mount the speaker in the center of one of the smaller squares.

The full enclosure mounting requires more construction work but results in a smaller unit and offers roughly twice the frequency rolloff of the flat baffle. There is no need to make the enclosure much larger than the speaker. However, it is important to completely enclose the speaker. Do not leave the back of the enclosure open. This will create a low frequency peak in the response curve, similar to the dip we experienced in the baffle design. In the full-enclosure design the speaker is mounted at the center of the enclosure.

Additional improvement in transient response can be had by driving the speaker from a low impedance source. In my case, the 8 ohm speaker is powered from a 3.2 ohm output transformer.

Speaker location will also have an effect on performance. In a mobile installation there may not be many choices regarding enclosures or location. Perhaps the best solution here is in the center of the dash, with the speaker pointing up at the windshield. Or, more normally, mounted in the dash, pointing up, with a backing of Fiberglas insulation behind the speaker under the dash. In a fixed station setting we have more choices. The best location would be in a corner. Either at the junction of two walls and the ceiling, or two walls and a desktop. This helps optimize the acoustical loading on the speaker cone.

Prior to building my own communications speaker/enclosure I was using the 5" x 7" speaker mounted in the open-backed speaker/power supply cabinet of my rig. Direct comparisons with this typical factory-supplied solution and the new speaker/enclosure proved that my efforts had not been in vain. Proper testing of a speaker/enclosure combination requires equipment that is not generally available to most amateurs. However, we all have ears. In the final analysis, it is the intelligibility of the audio we personally experience that will determine how well a particular combination performs. RF

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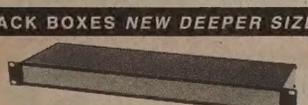

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1RU12	19 x 12 x 1.75	42.75	3RU5	19 x 5 x 5.25	46.00
1RU15	19 x 15 x 1.75	45.75	3RU7	19 x 7 x 5.25	48.50
1RU17	19 x 17 x 1.75	48.75	3RU10	19 x 10 x 5.25	51.00
2RU5	19 x 5 x 3.5	36.50	3RU12	19 x 12 x 5.25	54.00
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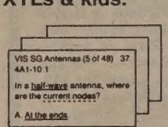

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new products

AMATEUR RADIO EXCELLENCE

Amateur Radio Excellence Products has introduced the ARE "Classic" Clock for the ultimate ham shack. Ham operators everywhere will appreciate the Classic's beautiful, original artwork dial, capturing the essence of the Golden Age of radio. The classic represents the finest value available today in a custom-made clock for radio amateurs.

The ARE Classic features a 12- and 24-hour dial, quartz accuracy, and a fully laminated artwork face with the call letters of your choice custom-printed with the art. These beauties are 100% crafted in the USA. The clock frame measures approximately 9" square by 2" deep, and is suitable for desktop display or wall mounting.

The ARE Classic is powered by one AA battery (included), and is gift-boxed in fine tissue. The dial face is dark brown on light beige; frames are available in simulated light oak, walnut, or black (shown) finishes. Please specify frame and call letters when ordering.

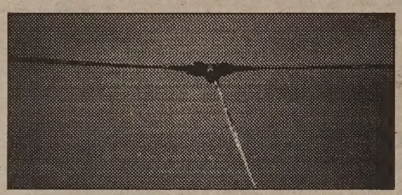
The price is $39.99 plus $4.50 shipping in the USA. (Foreign addresses add shipping FPO NH, USA.) For more information or to order contact *Amateur Radio Excellence, P.O. Box 1551, Dept. RF, Manchester, NH 03105.*

JADE PRODUCTS, INC.

Trying to get on the HF bands on a tight budget? This new Fun-Kit from Jade Products may be the answer you're looking for. The Ladder Line Windom Multiband Antenna Kit is constructed of the highest quality ladder line available, composed of copper-clad steel transmitting wire.

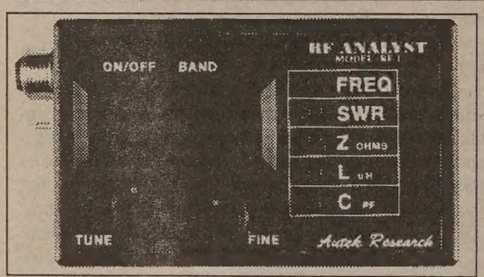
The Windom design is an "off center" feed antenna that has been popular for many decades. When used with a balun or tuner it allows the user the flexibility of operating on many frequencies with one simple antenna and providing an approximate 50 ohm load to the transmitter.

This antenna will cover all the HF amateur bands! It covers 80 through 10 meters, including the WARC bands. SWR on most



bands is 2:1 or less with the SWR slightly higher on 30 meters.

The kit includes heavy rubber-mounted ladder line center support tee, a 1:4 balun, and 50' of feedline (other lengths are available). The antenna is 134' long. To order or for more information contact *Jade Products, Inc., P.O. Box 368, East Hampstead, NH 03826-0368; (603) 329-6995; FAX (603) 329-4499.* Or circle Reader Service No. 202.



AUTEK RESEARCH

Autek Research has introduced the pocket-sized RF Analyst, designed to check and adjust antennas, feedlines, and RF networks. It includes a microprocessor, A/D converters, and a low-distortion leveled sine wave generator with four-digit readout. This device is continuously adjustable from 1.2 to 35 MHz in five bands. Measurements include RF impedance (0 to 2,000 ohms), SWR (1 to 15:1), C (0 to 9,999 pF), and L (<.04 to 300 µH). This range of digital readout information is unique in this price range.

The instrument connects to any antenna or feedline for instant readouts. L and C are measured at the frequency of interest, showing the true RF value of these components. Basic accuracy is 2.5% to 5% over most of its range. The instrument fits into a shirt pocket and runs on a 9 volt battery.

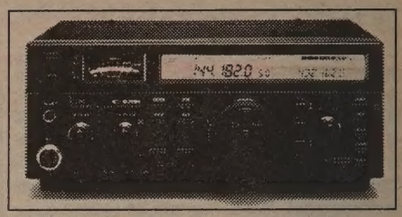
The Autek Research RF Analyst is priced at $129.95 plus $6 S&H (US). For more information or to order contact *Autek Research, 4143 W. Waters Ave., #120, Tampa, FL 33614; (813) 871-3805.* Or circle Reader Service No. 205.

ICOM

Icom has announced the IC-820H high-performance all-mode dual-band base station transceiver for 2 meter and 440 MHz operation. The IC-820H is compact and lightweight, making it ideal for mobile, fixed, or field operation. Yet, this new transceiver is packed with top performance features, including a newly-designed DDS capable of resolving 1 Hz tuning steps for fine-tuning.

Built-in satellite functions include normal and reverse tracking, independent uplink/downlink control for Doppler shift compensation, and separate satellite VFO. Ten satellite memories allow you to quickly switch from normal to satellite operation.

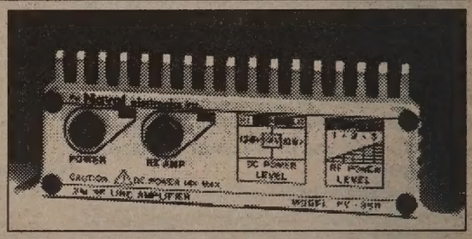
Independent controls and indicators for each band make the IC-820H easy to operate. Additional features include IF shift, memory allocation, AF speech compressor, auto repeater and one-touch repeater, built-in high stability crystal unit, RIT, CW semi break-in, and sidetone.



The suggested retail price is $1,999. For more information, visit your favorite dealer or contact *Icom America, Inc., 2380-116th Avenue N.E., Bellevue WA 98004; (206) 454-8155.* Or circle Reader Service No. 201.

NAVAL ELECTRONICS, INC.

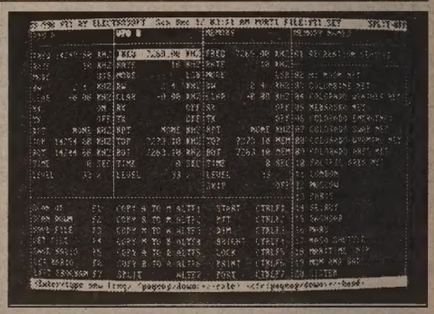
Naval Electronics has introduced their new all-mode PV-35R VHF Linear Amplifier incorporating a GaAs-FET preamp as well as RF power and supply voltage indicators. The unit provides a maximum output of 35 watts (30 out for 3 in). LEDs show output levels of 10, 20, and 30 watts and, at the same time, power supply variations from 10.5 to 13.8 VDC. This amp works in the FM, CW, AM, and SSB modes.



For more information contact *Naval Electronics, Inc., 5417 Jetview Circle, Tampa, FL 33634; (813) 885-6091, FAX (813) 885-3789.* Or circle Reader Service No. 203.

ELECTROSOFT

Electrosoft has introduced a program to control the Yaesu FT-990 transceiver. The program works on any PC or compatible equipped with a serial port and requires the FIF-232c interface circuit supplied by Yaesu.



The Electrosoft program reads the frequency, bandwidth, and mode for both VFOs and for 90 memory channels, then stores the data in a computer file. You can store an unlimited number of channel files. The program can read any previously saved file and reset the frequencies, bandwidths, modes, and scanning information quickly and easily.

The bottom line on the screen shows the command keys used to edit and the highlighted fields in the four top windows. The program is backed by a money back guarantee and is priced at $100. For more information or to order contact *Electrosoft, P.O. Box 1462, Loveland, CO 80539.* Or circle Reader Service No. 204.

WA1FFL

Wire antenna enthusiasts will be interested in a new center support device, the WA1FFL Ladder-Loc for 450 ohm ladder-line antennas. The device is constructed of calcium-reinforced polypropylene and features a built-in strain relief to take the weight off the wire joints at the feed point. It has overlapped construction to keep water out of the sides and is very sturdy.

The Ladder-Loc goes together quickly with two wing nuts; adding a touch of sealant will make it completely weatherproof. The product is priced at $11.95 plus shipping. For more information or to order contact *Radioware, P.O. Box 1478, Westford, MA 01886; (800) 950-9273.* Or circle Reader Service Number 206.

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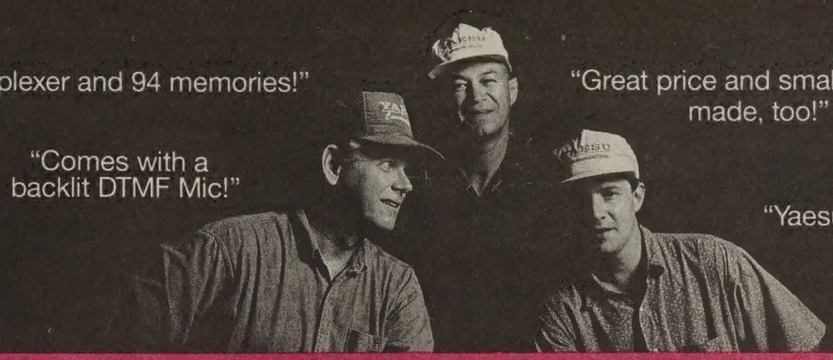
"Built-in duplexer and 94 memories!"
"Great price and smallest dual band made, too!"
"Comes with a backlit DTMF Mic!"
"Yaesu did it again!"

FT-5100
Dual Band Mobile

- **Frequency Coverage:**
  2M: 130-174 MHz RX
  144-148 MHz TX
  70 cm: 430-450 MHz RX/TX
- 94 Memories (47 per band) Odd Splits In Any Memory
- Dual in-band receive (V/V, U/U or V/U Receive Operation)
- DTMF Paging and Coded Squelch Included.
- Packet Radio TNC Jack Built-In To Back of Radio
- CTCSS Encode Built-In
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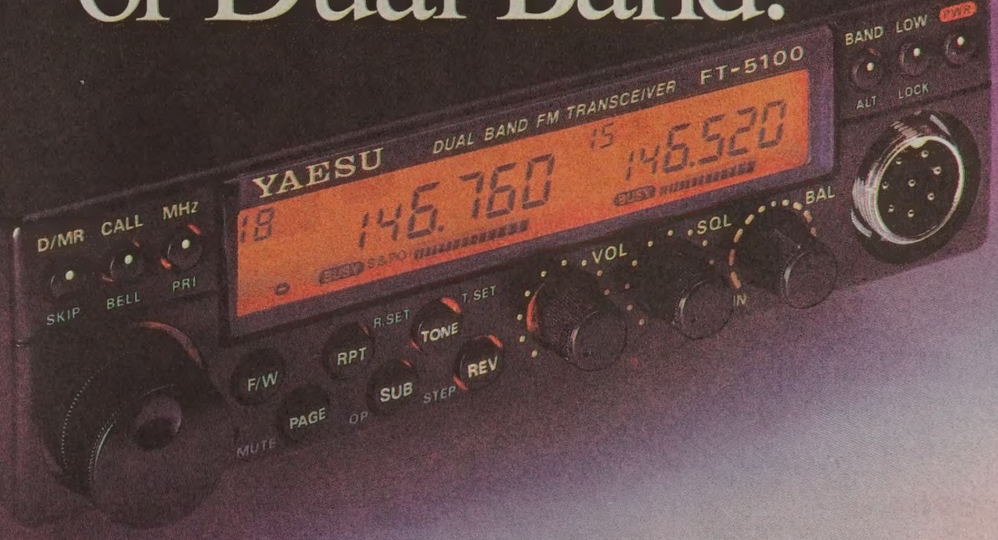
- Built-In Antenna Duplexer
- Back Lit DTMF Microphone
- Automatic 8 Level Display Dimmer
- Built-In Cross Band Repeat
- RF Output Power:
  2M: 50/5 watt (high/low)
  70 cm: 35/5 watt (high/low)
- **Accessories:**
  FTS-22 CTCSS Dual Decoder
  SP-7 External Speaker
  MW-2 Wireless Microphone/ Controller

The ultimate definition of Dual Band.



Now you can listen to two, 2 meter frequencies, or two, UHF frequencies, at the same time with In-Band Dual Receive*. Although equipped with traditional dual band, Yaesu has taken receive two steps beyond in the remarkable FT-5100. Combined in one compact mobile transceiver, it's the ultimate meaning of "dual band".

With 94 memory channels – more than any other radio in its class – and the optional MW-2 Wireless Mic, the flexibility of the FT-5100 is matchless. But to make sure the FT-5100 is complete, and an even better value, unlike the competition, there's a backlit DTMF mic included.

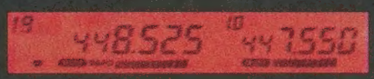
Through advanced miniaturization technology you'll find practical additions like the built-in antenna duplexer – an option on similar transceivers – and equally important, DTMF paging and coded squelch. All in the smallest dual band made!

Priced for the shrewd buyer, you've got to hear it to believe it. Dual band re-defined. Combinations like this can't be found anyplace else, so contact your nearest Yaesu dealer and tell him you want the "ultimate dual band". The FT-5100.

*In-Band Dual Receive available only on FT-5100.

Three Dual Receive Configurations

VHF/UHF



UHF/UHF

VHF/VHF

Dual band redefined.
And the choice is yours.

In-Band Dual Receive available only on FT-5100.

Here's another Yaesu exclusive! The MW-2 Wireless Mic with Remote Control.

FT-5200 Dual Band Mobile.

Offers the security of a quick release front control panel *(not available on the FT-5100)*, 32 memories, DTMF paging (w/optional FRC-4), Back-lit mic, built-in antenna duplexer and more.

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Specifications subject to change without notice. Specifications guaranteed only within amateur bands. Some accessories and/or options are standard in certain areas. Check with your local Yaesu dealer for specific details.

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